Sky and TELESCOPE

SEP 30 1948

I A U General Assembly

In This Issue

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LETTERS

Sir:

Since the end of the second World War, there has been some comment in Great Britain that in spite of the extremely important part our country has always played in astronomy, we have never possessed a planetarium, as that word is used in the modern sense.

The project of establishing two planetariums in England, one in the London district and the other in the North, has had a favorable reception in Parliament, but there is so much war destruction to be made good that it will be a number of years before they can be erected.

This 78-year-old Croydon Natural History and Scientific Society recently inaugurated a section for astronomy, and its members are taking a great interest in planetariums. Last year we had an eyewitness account from one of our members of his recent visit to the Hayden Planetarium, New York.

Few people in Great Britain are aware that what appears to be the first form of a planetarium was constructed in Cambridge, England, so long ago as 1758. The word "planetarium" in the past was often used for orrery, but it is a fact that Roger Long, professor of astronomy at Cambridge, caused to be made a large hollow sphere which held more than 30 spectators. The sphere was easily rotated by a winch. The constellations were painted on the moving concavity above the sightseers, the stars being pierced through "the metal according to the several magnitudes so that the light penetrates and each assumes a curious radiated or rather stellated form."

Long called his contrivance a "Uranium," but it appears to be the world's first kind of planetarium as the word is now understood.

G. E. W. GOSNELL, general secretary
Croydon Natural History and
Scientific Society
75 Woodmansterne Road
Coulsdon, Surrey, England

SKY JINGLE

The stars are like jackstones
A-throw on the sky.
So many are doubles,
The "onezies" don't try.

We might start at sevenzies
And toss up the Sun
And sweep up the Pleiades,
That would be fun.

Yet seven's not the count there,
That turn would be through,
For Alcyone is three stars
And one of those two.

So maybe the floor here
And plain jacks are wise,
'Til we're a bit surer
Just what's in the skies.

DOROTHEA HAVENS CHAPPELL

Sky and TELESCOPE

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In Focus

ON AUGUST 10, 1948, while Dr. Henry E. Paul, Norwich, N. Y., was making a one-hour exposure of a region of the Milky Way centered on the Scutum starcloud, a Perseid meteor flashed brightly down through the center of the field. The back cover this month shows a portion of the photograph covering a sky area of some 2,700 square degrees — 60 degrees from top to bottom of the picture.

The extreme wide angle (for astronomical photography) was achieved with a Bausch and Lomb f/6.3 metrogon lens (operating at f/8) for which Dr. Paul himself constructed the mounting, guide telescope, camera box, and precision plateholder. This apparatus and a similar picture were exhibited at the Stellafane convention (see page 296).

The meteor, which here is recorded as 25 degrees in length, also produced a visually observed enduring train; however, the slow lens did not record this. The plate is an Eastman 103aE spectroscopic, antihalation-backed, processed for six minutes in D-19 developer. The back cover represents roughly a 5 x 7 portion of the original 8 x 10 negative.

It is possible to identify many familiar objects in the field. The bright image in the lower right is the planet Jupiter. Above it one inch and two inches to the left is M8 in Sagittarius. A line through Jupiter and M8 extended one inch ends near Lambda Sagittarii, and the handle of the Teapot is easily picked out in the darker regions to the left of this star. Near the top of the picture, to the left of center, the brightest star image is that of 1st-magnitude Altair, in Aquila.

This picture illustrates the caliber of the work a serious amateur can do with specialized lenses available on the market today. It also shows the value of a suitable wide-angle lens for photography of the Milky Way and for catching meteors.

In the front cover picture, which shows the Astronomer Royal of England conducting a general assembly session of the International Astronomical Union, those seated at the table are, left to right: Dr. Donald H. Menzel, U.S.A.; Dr. P. Swings, Belgium; Miss H. A. Kluyver, Holland; Dr. Joel Stebbins, U.S.A.; Dr. A. A. Mikhailov, U.S.S.R.; Dr. J. H. Oort, Holland; Dr. A. Danjon, France; Dr. G. Abetti, Italy; Dr. G. Tiercy, Switzerland; and Dr. Paul Couderc, France.

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COVER: Sir H. Spencer Jones, Astronomer Royal and retiring president of the International Astronomical Union, conducting the closing sessions of the general assembly, Zurich, Switzerland, August 18, 1948. Photo by C. A. Federer, Jr. (See In Focus.)

BACK COVER: A wide-angle photograph of the Milky Way and a Perseid meteor, taken August 10, 1948, by Dr. Henry E. Paul, Norwich, N. Y. (See In Focus.)

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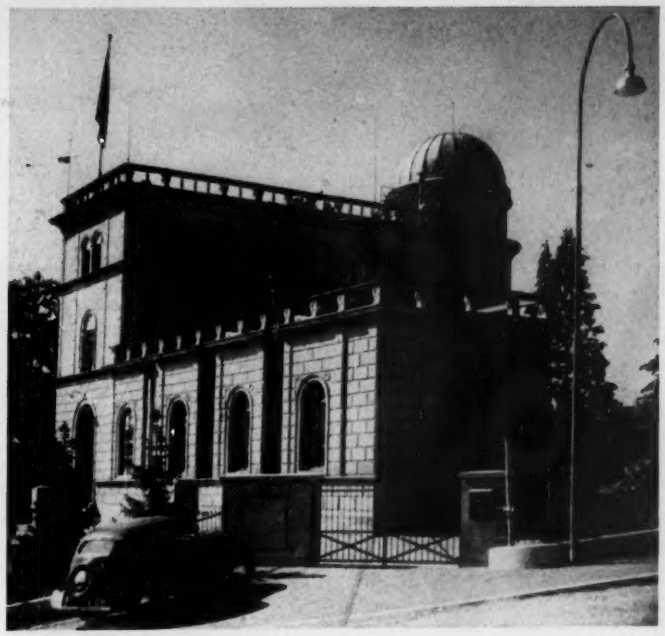
CONGRESS IN SWITZERLAND



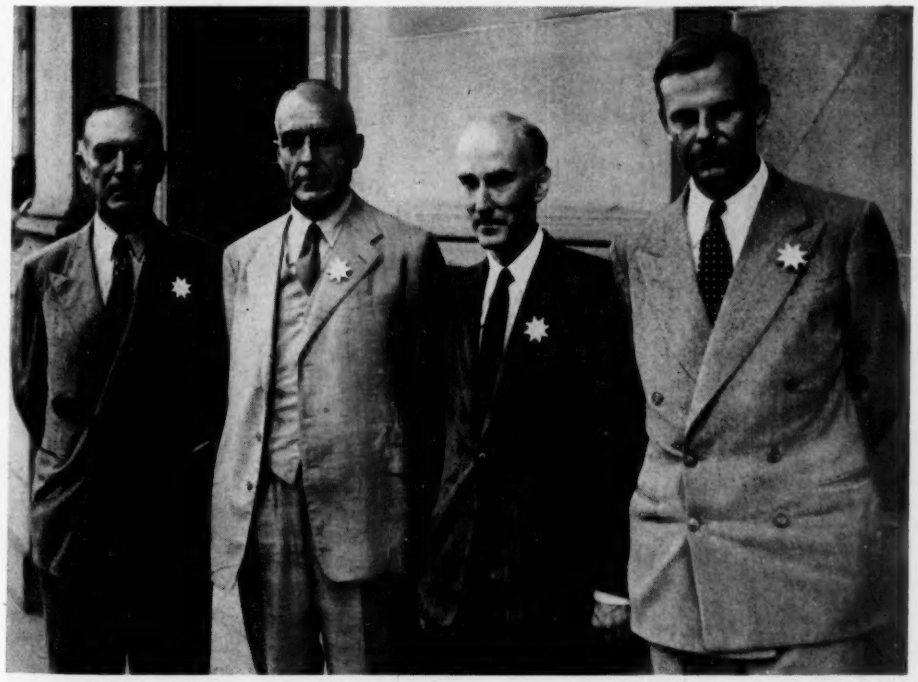
The Federal Observatory at Zurich. The famous Wolf sunspot numbers were originated by the first director of this institution, R. Wolf.

TWO-SCORE COMMISSIONS form the principal operating units of the International Astronomical Union, an organization supported by at least 30 nations. It was primarily to see one another and attend the sessions of these commissions that some 400 astronomers, including a tenth of that number from the United States, journeyed from near and far to the first IAU meeting in 10 years. The program was arranged and all details carried out by the Swiss Federal Observatory, Zurich, Switzerland, currently celebrating its 100th anniversary.

Some of the commission meetings featured papers by astronomers concerning recent work, and the program was highlighted by a symposium on the abundance of the elements, astronomers from seven countries taking part. Commission 29 conducted a symposium on stellar spectra, and Dr. E. P. Hubble, of Mount Wilson Observatory, gave an informal talk on the construction and projected program of the 200-inch telescope, principally for the benefit of European astronomers.

Scarcely second to the scientific interests of the week-long program were the social and sightseeing events sponsored and financed in large degree by the Swiss federal government. The official banquet at the Kongresshaus could hardly have been surpassed in the quality of its viands, and the entertainment provided was typically Swiss. Several days were devoted to visits and excursions, by boat, train, and automobile, to some of the nearby points of scientific interest and to the mountain regions.

Of considerable importance to all the visiting astronomers was the opportunity to visit observatories and scientific institutions in many European countries. After the Zurich gathering, Professor M. Waldmeier, host astronomer, led an excursion to the solar observatory at Arosa, Switzerland, where a coronagraph is in operation. Another excursion was made to the Hochalpine Forschungsstation and the Sphinx Observatory, at the terminus of Switzerland's highest railway, on the Jungfraujoch, 11,340 feet above sea level.



Incoming and retiring officers of the IAU. Left to right: Dr. Bertil Lindblad, Stockholm Observatory, Sweden, president; Dr. H. Spencer Jones, Astronomer Royal of England, retiring president; Dr. J. H. Oort, Leiden Observatory, Holland, retiring secretary; Dr. Bengt Stroemgren, University of Copenhagen Observatory, Denmark, secretary. Dr. Lindblad and Dr. Stroemgren took office at the closing session of the general assembly at Zurich.

Although a decade has elapsed since the Stockholm meeting in 1938, it is quite apparent that astronomy in Europe has been actively pursued, even during the war years and in some countries most seriously affected by hostilities. New astronomical observatories and astrophysical institutions are springing up in many parts of Europe, with particular emphasis on studies of the earth's atmosphere, the sun, and solar-terrestrial relationships.

Great interest was shown, therefore, in the doings of Commission 39, for the creation of international observatories, of which Dr. Harlow Shapley, Harvard College Observatory, is president. In his report to the union, Dr. Shapley stated that the commission members were in general agreement that any new international observatory should be located between 10° and 40° south latitude. A large Schmidt camera should be the first instrument built, and then a reflector of aperture between 75 and 125 inches. The site should be noted for its fine seeing, preferably at an altitude between 6,000 and 10,000 feet, with not less than 225 clear nights per year and no two-month period more than 50-per-cent cloudy. It is expected that these specifications will be very hard to meet, but to conduct a site survey Commission 39 is seeking a grant of $50,000 from UNESCO or some other international body.

Meanwhile, at the commission meeting, Dr. Shapley proposed and received enthusiastic support from astronomers of many countries for the establishment of an international central laboratory of

The Swiss Federal Institute of Technology (Eidgenoessische Technische Hochschule) where all scientific meetings and assemblies were held. Here also was shown an exhibit, in part arranged for the 100-year jubilee of solar research at the Swiss Federal Observatory.

astronomy. The first unit of such a laboratory might well be one of the new high-speed calculators which are proving so useful in carrying out astronomical computations. Another proposal was the standardization of observing procedures by small committees of the IAU, so that Schmidt camera and spectrum plates might be taken in strict accordance with such rules and then shipped to central laboratories for analysis. One way in which an international astronomical laboratory might be established is through an association of contributing observatories. This project should be easier to develop immediately than that of an international observatory, and should serve to demonstrate just as well the practice of internationalism in astronomy.

Dr. M. Waldmeier, director of the Swiss Federal Observatory, host astronomer to the IAU congress.

Distribution in longitude as well as in latitude for solar observing stations is one of the problems confronting solar astronomers today. In his report as president of the subcommission on the cinemaphotography of prominences, Dr. Bernard Lyot, of the Pic du Midi Observatory, pointed out that the four observatories actually equipped for prominence motion-picture photography are all situated within 115 degrees of longitude. These are at Arosa, Switzerland; Pic du Midi, France; Pontiac, Michigan; and Climax, Colorado. Two observatories in France, Meudon and Haute Provence, will also soon have suitable equipment in operation, but they do not solve the need for distribution in longitude. With present observatories and complete co-operation between them, a continuous film of solar activity in, say, hydrogen-alpha light, should be possible for from 12 to 18 hours each day during summer, and six to 12 hours each day during winter, but bad weather can still cut into these periods. Observatories in the Orient and in the Southern Hemisphere are needed to insure complete coverage of the sun's around-the-clock activities.

Problems of solar observing are becoming more and more complex. Before a meeting of the mixed commission on solar and terrestrial relationships (of the IAU, the International Union of Geodesy and Geophysics, and the International Radio-Science Union) held on August 10th, Dr. Waldmeier listed six kinds of "radiation" from the sun, each variable and influencing terrestrial events in a different way. For instance, ultraviolet outbursts, probably from the solar corona, cause ionospheric storms to affect radio communication on the earth. Slow-moving electrified particles from the corona and fast-moving particles blown off of the sun by eruptive prominences may explain magnetic storms and the aurora.

Most recently discovered, and as yet hardly explained, is the sun's radio energy, which consists of a continuous, though varying solar "noise" and of irregular, unpredictable outbursts on various frequencies. The correlation of this radiation with sunspots and other visible solar phenomena is as yet very imperfect, but the work of Dr. K. O. Kiepenhauer, of the Fraunhofer Institute, Freiburg, Germany, on the effects of meter-wave radiation (300 megacycles) on vegetation and animals, indicates that such solar emanations may be of great significance in human life. Plants subjected to meter waves of the low intensity of one volt per meter distance stopped growing in four or five days. The same radiation at only 1/1,000 volt per meter, however, seemed to stimulate cell mitosis, as the results of thousands of experiments showed. Meteorologically, too, meter waves may play a part, for a "radar fog" can be produced in moist air with beams of this energy. The frequency of solar and lunar halos has been shown to be associated with the sun's own activity cycle.

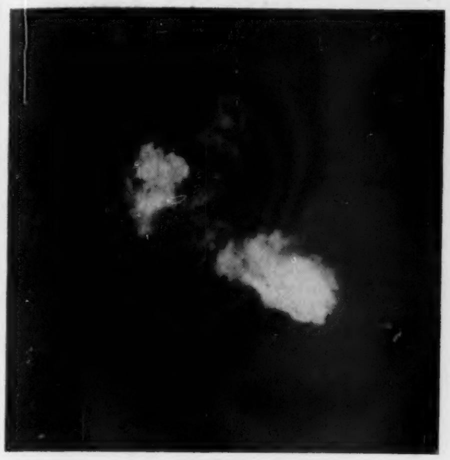
At Zurich, solar problems were not just talked about. On clear days, between meetings, astronomers visited the Swiss Federal Observatory to observe the entire solar disk in hydrogen light through an improved filter devised by Dr. Lyot. This monochromator has a passband width of only 7/10 of an angstrom, provided its temperature is very

(Continued on page 302)

The Urania Observatory in Zurich, where public observing nights are regularly held.

Tracing the Norton, Kansas, Meteorite Fall

By H. H. Nininger, *American Meteorite Museum*



The meteor cloud approximately three to five minutes after the explosion. The engraving is made from a Kodachrome print taken by J. Wilburn Lewallen, with an Argus C-3 camera, 1/100 second at f/4.5. The observation point was very nearly beneath the explosion, on the northeast quarter of Section 6, Garfield township, Norton County. Mr. Lewallen has offered color prints of this picture, size 2¼ x 3¼ inches for $1.00; 3 x 4¼ for $1.50. Inquiries may be made to him directly at Norton, Kans.

ABOUT 4:00 p.m. Mountain standard time, February 18, 1948, the Denver *Post* began receiving telephone calls from local citizens regarding a "brilliant meteor," "burning plane," "V-2 rocket," "flying saucer," that had been seen in an easterly direction. Soon dispatches on the wire reported from locations in Kansas, Nebraska, western Oklahoma, northern Texas, New Mexico, and from all over eastern Colorado. Great explosions, brilliantly lighting the daytime sky, were reported from various towns in the vicinity of Norton and Decatur counties, Kansas.

We later learned that a telephone call to our museum (near Winslow, Ariz.) had failed to get through that night; but on the following morning the *Post* reached us for an opinion as to what had taken place. Sufficient information was eventually supplied for us to conclude definitely that an exploding meteorite had in all probability scattered fragments in the Oberlin-Norton region of Kansas. No other scientist had then announced his intention of making a survey, and we informed the Denver *Post* that we would leave within an hour to begin a survey to determine the flight of the meteorite and the possible location of fragments.

That night we slept several hundred miles nearer to our objective and by daylight were on our way again. Before noon we were having on-the-spot interviews, thus adding richly to our fund of general information. Our first interview was with a bridge-repair crew northeast of Tucumcari, N. M., where U. S. 54 crosses the Canadian River. These men had seen a fireball followed by a train of "smoke" traversing the northern sky. We had stopped to interview them because we surmised that the job they were on had been in progress at the time of the fall and that they had been in a position to see it.

At Guymon, Okla., two men working on a grain elevator were startled by what they thought was a burning plane. They drove hurriedly to where it apparently crashed behind the hill to the north of them six miles, but found nothing.

In Hugoton, Kans., Mrs. Paul Reese, working at her kitchen sink under a north window, saw a huge fireball moving eastward near the horizon. It vanished in a brilliant burst, leaving a silvery cloud in its wake.

Interviews we obtained in Dodge City, Jetmore, and Scott City, Kans., respectively about 150, 125, and 110 miles from the meteor's path, portrayed a normal meteorite fall except that its course appeared to change at the point of the first explosion. These observers all insisted that after an apparent explosion which left a "puff" of smoke the fireball, reduced in size, continued onward but dipped more abruptly toward the earth. This behavior is characteristic of meteorites during their post-luminous flight, but in this case luminosity continued after the explosion. Later interviews with observers under the line of sight revealed that this change of course was in reality a slight turn to the right, as well as downward.

Other cases are known of such changes in the courses of exploding meteorites. The largest stone recovered from the Archie, Mo., fall of August 10, 1932, diverged 30 degrees from the visible course of the fireball as it left the cloud puff. An asymmetrical form for the missile may result in pocket accumulations of impacted air. Explosions of superheated air or a spalling of the meteorite may cause the principal surviving remnant to deviate from the original course. Such friable and heterogeneous varieties as the Norton meteorite later proved to be are particularly well suited to such behavior. It was precisely the erratic behavior of this Norton meteorite which led the writer to caution his audience specifically to look out for light-colored as well as dark-colored stones, when he spoke in the Norton High School on February 23rd, five days after the meteorite fell.

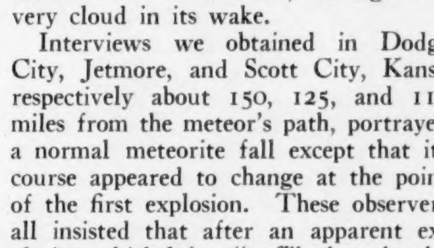


Fig. 1. Sketches of observers' impressions of the explosion clouds.

The meteor cloud about 15 minutes after the fireball vanished. Photo by Duane Wray, a student of Norton High School.

We slept at Oakley on the 20th, after some 18 hours of driving and interviewing witnesses that day. Out early the next morning, we found the public and the press still uncertain as to what had taken place, but interest was waning. In Oakley, Frank Phelps, owner of an auto repair shop, stated he was in his car headed east, paused at a stop street, when he saw the meteor descend in an almost vertical plane but bearing a little to the right after the explosions. His sketch is Fig. 1a. The bearing he gave passed about three miles to the west of Norcatur.

Also in Oakley, we interviewed Jerry Mersham, who had been playing basketball with a number of other boys. His bearing agreed substantially with that of Mr. Phelps but lined up precisely with Norcatur.

An ex-artillery officer was certain the talk was all about a V-2 rocket that had

gotten out of hand. Much of our time was consumed listening to weird ideas, but our factual information was constantly increasing. In Halford, Alvin Rohn drew for us a sketch (Fig. 1b) showing that the meteor had passed on the right of that point, but the direction of the end point was a bit uncertain. At Studley, Dave Pratt and James Spencer described the location as due north, and sketched the meteor's course as in Fig. 1c. All witnesses agreed that there were two puffs of cloud and that the visible flight continued afterward.

In Lenora, six miles west and 16 miles south of Norton, J. O. Faubion was in the act of sitting down on a bench in the yard when his wife called across the street for him to look at the fire in the sky. He walked 30 yards into the street before the meteor burst 48 degrees west of north and at an elevation of 46 degrees, according to his memory and as indicated by pointing.

Ross Hines, Lenora town marshall, was riding on a road grader going north when he saw a "red spark" followed by a vapor trail. This first appeared to the west and south of him. The grader was traveling at 12 to 14 miles per hour and moved about 500 feet before the meteor burst at an elevation of 56 degrees and about 23 degrees west of north. It required 43 seconds for the sound to reach him, according to his timing from memory.

A. J. Kipp, a lumberman at the same place, was walking westward to his office when he saw the fireball pass at an elevation of about 75 degrees. It exploded in a north-northwest direction. He walked to his office, stopping to shut a large gate before the sound reached him — 70 seconds according to a repeat performance. The disagreement as to elevation is disappointing, but is quite characteristic of what is met with in all such surveys.

All these witnesses agreed that a post-explosion, smoking missile traveled downward and eastward some 10 to 12 degrees beyond the meridian and disappeared behind trees. This definitely indicates that a mass carried farther east than where the 100-pound McKinley stone was later found. At Norton, as elsewhere, many persons observed incipient "smoke" streamers growing on the rounded puff of cloud, which is regarded as positive evidence that ponderable fragments survived.

As is usually the case, those who heard the explosions and then saw the clouds were far more numerous than the persons who saw the fireball. In Norton, Norcatur, Oberlin, Lenora, Hill City, Morland, Studley, Halford, and Oakley in Kansas, and in Hendley, Wilsonville, and Lebanon in Nebraska, witnesses reported that buildings shook, dishes rattled in cupboards. A farm wife thought her husband had run into the side of the house with their tractor.

Harold Holste and Lester Applegate, working eight miles west and two miles north of Norton, felt very strong air pressure against their backs as they stooped over at their work.

February 22nd was spent rounding the end point of the meteorite's flight by visits to Beaver City, Hendley, Wilsonville, McCook, and Lebanon. We included points to the west near Oberlin, Kans., and finally we reached Norcatur, where the fireball passed directly overhead, bursting just after it had passed the zenith.

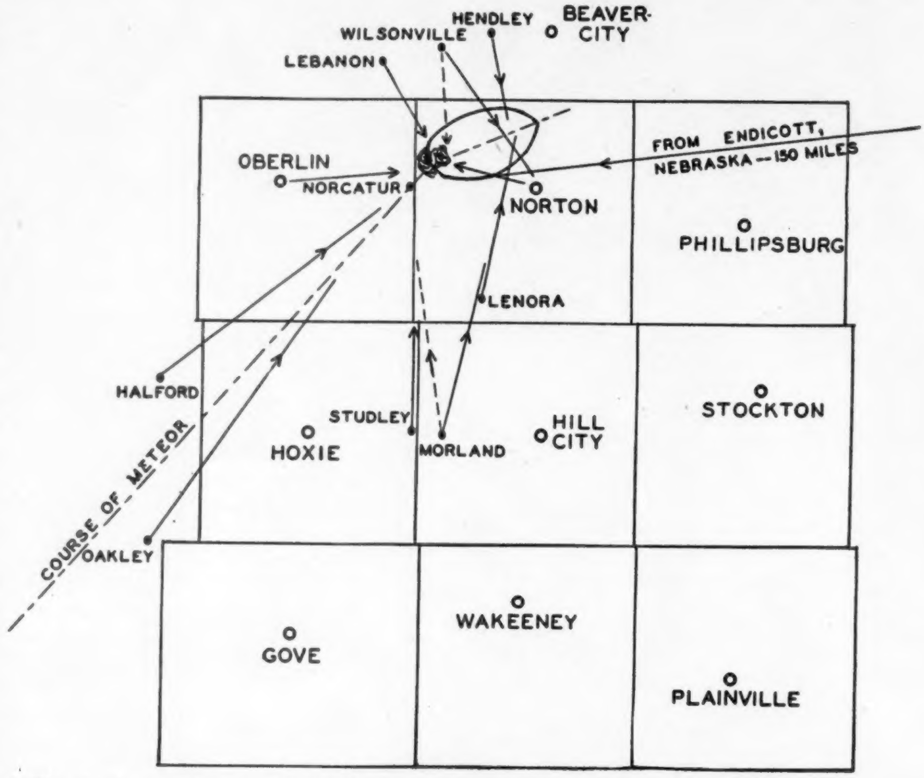


Fig. 2. A county map of the Kansas area most concerned with the fireball, including four communities in Nebraska. The direction of first observation is marked by dashed lines; of the vanishing point, by solid lines. The ellipse is the area designated by the author for meteorite search.

At Wilsonville, Nebr., Ed Hummell was on the west side of Main Street, facing south, approximately seven or eight feet from the front of a store building which is 20 feet high. The meteor appeared coming over the building at an elevation of 33 degrees and descended to the east, disappearing while yet 15 to 30 degrees above the horizon in a direction 35 degrees east of due south. It is important to note that this observer did not see any "puff of smoke" but only a narrow, straight, silvery ribbon. Therefore, he saw only the descent of the last surviving fragment. The cloud puff was hidden by the building. Observers in Hendley and Lebanon agreed substantially with Mr. Hummell.

In Norcatur, slightly west of south from Wilsonville and almost due west from Norton, Postmaster Ralph New was standing at a large north window watching children at play on the steps of City Hall across the street, east-northeast from him, when he saw the fireball one half the size of the full moon descend in a "vertical" plane and disappear behind the tower on the city hall. He stepped to a door a few feet west of the window and leaned out, looking up to follow the line of "smoke" back to see whence it had come. He looked nearly straight up along the brick wall of the building and saw two elliptical clouds, in length about twice the diameter of the full moon and connected by a somewhat narrower line of smoke. The location pointed out for these clouds measured respectively 75 and 78 degrees above the horizon.

Here are two very important observations which furnish evidence that the 100-pound stone found on the McKinley ranch was not the only large surviving mass: To Mr. Hummell the meteor vanished almost in the direction of where the 100-pound mass was found but was still 15 to 20 degrees above the horizon and descending at not more than 20 to 30 degrees from the horizontal. Mr. New, who was practically in the vertical plane of the descent from the bursting point, was quite definite in pointing out the direction of disappearance at 52.5 degrees east of north. These lines of observation cross at a point four miles almost due south of where the 100-pound mass was found. For Mr. New to have been looking at the path of the mass that was found, he would have had to err 15.5 degrees in his memory of direction, which would have placed not

only the belltower, but the entire City Hall, out of line. And for Mr. Hummell to have been seeing the trail of the largest fragment found would mean that he was even more in error. In view of his situation relative to buildings, the street, and other surroundings, such error seems out of the question.

The 100-pound mass probably represents a carry-on in the original direction of flight from the point where the great bulk of the meteorite went to pieces. It left nothing but a vapor trail from the point of disintegration to its landing place and was followed by numerous small fragments in its wake which dropped out along the way and were found south and southwest of its destination. These were fragments found on the Tansill farm and the smaller pieces found on the McKinley ranch. These all together were probably insignificant in comparison with the amount of material which went into the formation of the cloud, and the principal survivor proceeded in a more easterly direction.

This belief is confirmed by the report of George Davis, who lives about the center of section 18 in the township east of where the large 100-pound mass was found, and about 1¾ miles south of that place, and was standing out in the open at the time of the fall. After the dust cloud was formed he saw two pieces, one passing to the north and the other going east on the south side of him. Of course, they were high overhead. His observation point is shown on the township chart as a small open circle.

The information now in hand made it plainly evident that the meteorite had passed about midway between Oakley and Halford and directly over, or slightly north of Norcatur, and that it had burst over a point three or four miles northeast of Norcatur at an undetermined elevation. As a working hypothesis, we assumed the height of the bursting to be that normal for most meteorites — about 10 to 12 miles — but up to that time our reports on elevation had been very conflicting and allowed of no definite conclusion. We later decided that the burst occurred at a height between 15 and 20 miles.

It should be borne in mind that the so-called "main masses" of meteorites mentioned in meteorite catalogues refer only to collected material and bear no necessary ponderable relation to the original invading masses. A reasonable supposition is that the cloud which formed over the Norcatur area represented many tons of material and that the disintegrating force which destroyed it may readily have changed the course of the largest surviving remnants. Smaller fragments, on the other hand, did not have sufficient momentum to carry far and consequently fell rather directly downward. We assumed that these were mostly small and that they would lie on top of the ground. Therefore, we mapped the area northeast of Norcatur for these fragments, rather than trying to locate the large mass which we believed had carried on to the east.

A lecture was given in the high school at Norton and another before a father-and-son banquet in Norcatur, in order to prepare the people of the region for finding the fragments which we were certain had landed.

With Ben Hendricks as pilot, I made an airplane flight over the area the next day and one good prospect was located. We flew up and down the axis of my designated area, beginning four miles east-northeast of Norcatur and turning back at a point 8½ miles north of Norton. Then we rounded this axis at intervals of about one-half mile. Our objective in the flight was to look for surface fragments and for possible small soil disturbances such as are caused by the intrusion of stones of 10 to 200 pounds in weight. Once we landed at a point about one mile south of where Mr. Tansill later found the first fragments and examined a peculiar shallow crater about three feet across. We finally concluded that a piece may have ricocheted from it.

Before we could look this territory over the next morning, however, it was covered with snow, rendering nil the prospects of finding meteorites immediately. Later, in May, after fragments had been found, the same pilot took me over the region again and we were pleased to note that the axis of the area which I had mapped for search, in February, lay only about ¼ mile from where the first specimen had been found, as shown on the large-scale chart. On this flight we saw the hole where the 100-pound mass had been removed. We decided that we must have flown on both sides of it six weeks before but had failed to see it.

A rapidly moving plane is not of too much service in looking for meteorites. Nevertheless meteorite searchers frequently use planes rather than pass up any possibilities of a find. Our search area was eight miles wide by 12 miles long, in the form of an ellipse.

The meteorite itself turns out to be an achondrite, of a variety which differs apparently not markedly from that which fell at Cumberland Falls, Ky., in 1919, nor from the fall at Pena Blanca Springs, Tex., in August, 1946. The arrival of two such rare meteorites within a period of 18 months and only about 1,000 miles apart again gives point to the suggestion made by the writer in 1938 that probably "rare" meteorites are not really scarce but that their arrival simply passes unnoticed. It is doubtful that this meteorite would have come to light as quickly as it did had it not been for the intensive campaign above described, which made the residents of the area keenly aware that something important had almost certainly landed in their vicinity.

Added in press: On August 16th, Harold Hahn, of Wilsonville, Nebr., called our museum and said, "My name is Hahn. Remember you talked to me last May on my tractor down at the corner and asked me to watch for holes in my field? We have uncovered a stone 39 inches across at the bottom of a six-foot hole in my wheat field."

Mrs. Nininger and I immediately drove to Norton for the third time, where we examined this great meteorite. It had been badly shattered by the impact and had suffered additional damage from unskilled digging.

The location is about 1½ miles due north of the 100-pound mass found previously, ¾ mile north of the Kansas-Nebraska line. But while there we gathered still more convincing evidence that the principal mass fell farther east and south, probably beyond the eastern extremity of our original search area.

H. H. N.

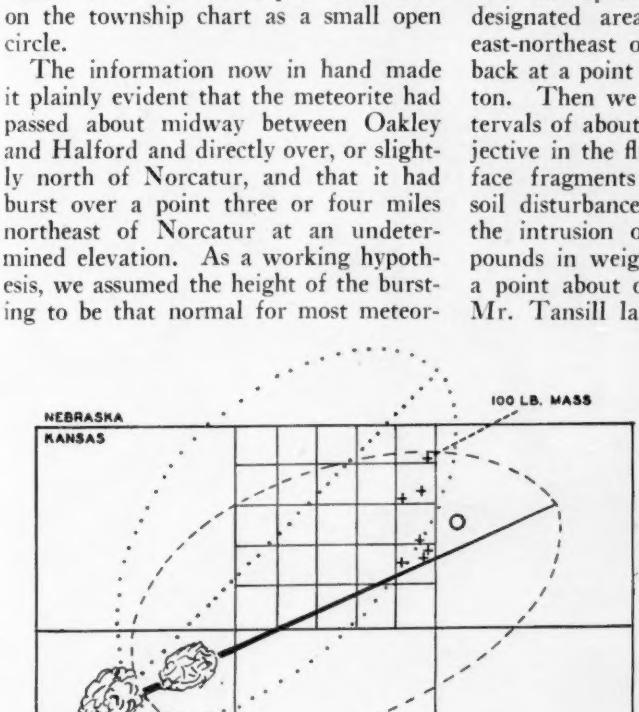


Fig. 3. The ellipse designated for search on February 23rd is in dashed lines; the area which would have been selected for a normal meteorite is dotted. Crosses mark locations where finds have been made, to the author's knowledge, but other fragments are said to have been discovered. The small circle is the observing point of George Davis. Section lines in Rock Branch township are schematic — a township has 36 mile-square sections.

CONVENTION - 1948

BY ROBERT E. COX, *Staff, Sky and Telescope*

LATE in the afternoon of August 6th the vanguard of visitors to the House of the Stars, at Springfield, Vt., began arriving for the second postwar meeting of telescope makers. Although the official gathering was not scheduled until the following day, many have learned in the past that by coming early they can secure an extra night of clear Vermont skies. This year they were treated to an excellent display of northern lights and a night of such good seeing that, as one visitor put it, "The North America nebula was practically a glaring object with a pair of 7 x 50 coated binoculars."

Saturday morning was fair, but by lunchtime the sky was so solid with clouds that the prospects of another good observing night seemed remote. Even in the dim flat lighting, cameras were busy recording the arrival of new instruments — there were probably four times as many cameras as telescopes present.

Three instruments were brought by Dr. Henry E. Paul, Norwich, N. Y. He had an f/0.8 Schmidt of moderate aperture, a folded-type 6-inch refractor (see *Scientific American*, May, 1948), and a Bausch and Lomb wide-angle lens, which was used on August 10th to take the Perseid meteor photograph on the back cover of this issue. With six telescopes, the Springfield, Mass., STARS displayed the largest number of instruments for any one society. Two of these telescopes have specially designed spider supports that help eliminate the bothersome diffraction of the conventional three- and four-legged supports. The principle involved is to mount the diagonal on the periphery of a circle whose diameter equals the radius of the tube, with the flat located on the optical axis of the mirror. The diffraction of this circular support is spread around the circular star image and not concentrated in lines of light through the star. In the telescopes of R. R. LaPelle and Jack Welsh, a 6-inch and 10-inch, respectively, the supports are of 1/8-inch iron bolted to the sides of the tubes. Mr. LaPelle said he could successfully separate stars only 0.7 second of arc apart with this new diagonal, using a power of 265 on his 6-inch instrument. He was unable to do this with the conventional support of four arms. The new support seems to have great possibilities — many of the visiting amateurs planned to try it as soon as they returned home.

The number of war-surplus items used as accessories was noticeable, and many very fine finders were displayed made from such equipment. Some dissatisfaction was expressed to the writer concerning war-surplus and other optical supplies offered to the amateur today. Few of these reports had to do with the quality of the products concerned, and it is suggested that every amateur purchasing such equipment make known to the seller any feelings of disappointment (or of satisfaction) he may have. Only in this way can optical goods producers and suppliers know the amateur's requirements and maintain a proper standard for their materials, especially as there is such a rising demand for inexpensive optical goods which must, nevertheless, be of good quality to satisfy even the simplest of astronomical requirements.

Most of the eyepieces used on the instruments at Stellafane were coated. The excellence of the performance of these lenses leaves little to be desired. Orthoscopic eyepieces are gaining in popularity — for the beginner or occasional user a Ramsden eyepiece is satisfactory, but if one wants to do serious work with a good telescope, a coated orthoscopic eyepiece with its wide, flat field is a must.

At about 5 o'clock, when registration closed, 213 persons had signed the official book. The most distant traveler was G. Fred Berger, of Buenos Aires, Argentina. Shortly thereafter, everyone began thinking more about food and less about instruments. The dinner was served by Ross McKinney, a famous Maine guide, who later told stories of the outdoors and anecdotes of the woods. Steak was served, and corn on the cob, salad, beans, corn bread, coffee and ice cream. The sky cleared during the meal, and then everyone gathered for the informal evening speeches, with John M. Pierce, of the host society, acting as master of ceremonies.

The first announcement was a great disappointment for all: Russell W. Porter and Albert G. Ingalls could not attend the meeting this year. The former

A camera with a Bausch and Lomb wide-angle lens, mounted and adapted for astronomical photography by Dr. Henry E. Paul, Norwich, N. Y., who is in the center of the picture. On the left is Edwin Root, Rochester, N. Y., and at the right is Bennett Cleveland, of Elmira, N. Y.

Above: R. R. LaPelle (center) and his 6-inch reflector with a circular secondary support.

Right: Amateurs inspect the prize-winning telescope built by A. V. Whipple, Montreal, as he demonstrates one of the motions of the instrument.

wrote a letter of regret and telling about his recent experiences with the 200-inch Palomar instrument. Dr. Porter had already sent, however, a water-color painting of the S. S. *America* after she was crushed in the ice in November of 1903, this painting to be the first prize in the Stellafane exhibits competition. Dr. Porter was a member of the Fiala-Ziegler arctic expedition which abandoned the *America* in a bay of Crown Prince Rudolph Island, latitude 82° north, the most northerly land in the Eastern Hemisphere.

This first prize went to A. V. Whipple, of Montreal, Canada, for his first effort, in his 68th year, in telescope making, an instrument with several novel features. The polar-axis ring bears divisions for days and months, making use of the hour-circle co-ordinates a simple matter. The mounting is collapsible, with the polar axis serving partly as its own support. For having the most instruments on display, the STARS society won the second prize, a recently autographed picture of Mr. Porter taken at his desk at California Institute of Technology.

Among the speakers of the evening, Stanley Brower, Plainfield, N. J., described the 20-inch reflector he is completing for the University of Krakow. This instrument, financed by voluntary contributions, will be the largest telescope in Poland.

George V. Plachy, secretary of the Amateur Astronomers Association, New York City, announced that the society's amateur astronomers medal had been awarded to Dr. Porter and presented to him by "Unc" Ingalls at the June dedication of the 200-inch telescope. Asked if Dr. Porter might think this medal should go to another, as it is awarded for meritorious service to astronomy by an amateur, Mr. Ingalls had replied that Russell W. Porter always thought of himself as an amateur.

Darkness soon beckoned everyone to the telescopes to view the 3-day-old moon before it set. All the instruments used for observing were of the best, and it is unfortunate that time did not permit an evaluation of the performances

R. W. PORTER'S LETTER TO STELLAFANE

To the Amateur Telescope Makers of Springfield, Vt., and to all other Victims of Mirror Making assembled at Stellafane,

Greetings:

You may be sure I regret not being present with you tonight, but the stress of other work has made this impossible. But I am very much with you in spirit.

Stellafane has a character all its own; the birthplace of the telescope hobby, its adherence to the rule that no one can become a member without first by the sweat of his brow having finished a satisfactory mirror. There will never be another Stellafane.

We also have a pretty good-sized telescope out here, with a mirror 16½ feet across its face. And it won't be long now before it begins plumbing the depths of space out to a billion light-years. At present we are putting the finishing touches on the mirror supports, to obtain the very best paraboloid under all positions.

Its light-gathering power is amazing. I was looking at the Hercules cluster the other night at the coude focus (f/30) with a power of about 900. The star images at the center of the cluster had never before been resolved. But they were completely separated against a dark sky background, and so bright as to require only a few seconds photographic exposure.

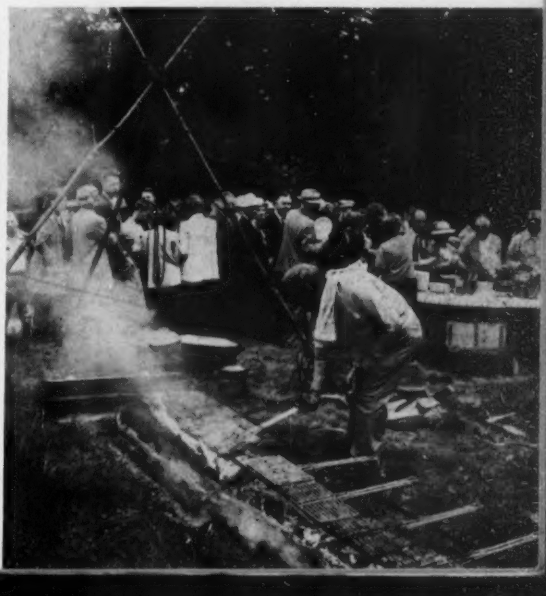
Now don't get too impatient to see the 200-inch getting down to actual work. Its mirror is an exceedingly elastic one, the surface depending on adjustments of its 36 supports. Many more Hartmann plates will be needed before the green light goes on. We already know that the mirror is a darn good one.

My own work on the project is now about over — 20 years of intensive application. It has been a great privilege, and it's been a lot of fun. Good night.

RUSSELL W. PORTER

July 27, 1948 Pasadena, Calif.

Ross McKinney preparing the steaks over open fires.



of the various telescopes there. But we did note that Mr. LaPelle's instrument, with a Barlow lens and a 5/8-inch eyepiece to give 265 power, split clearly the double star Zeta Herculis, magnitude 3.0 and 6.5, separation about one second of arc. Chester Cook, of the Boston ATM's, procured excel-

Ricky Cox inspects a 6-inch reflecting telescope by E. C. Taylor, Middletown Springs, Vt. All photographs with this article, except that of Dr. Paul's instrument, are by the author.

lent definition with his 5-inch off-axis reflector. This mirror was cut from a 12½-inch disk after it had been figured, and showed no signs of distortion.

Early in the evening, about 10 o'clock, Jupiter was viewed through Dr. Paul's 6-inch folded-type refractor. The air had not quite settled down, but even then the image given by this instrument was very good. Also operating well was the 6-inch reflector by Richard Luce, of the New York Optical Division. His mounting is rigid, portable, and very convenient to use, with optics leaving little to be desired.

Once again the northern lights began to appear, gradually turning into a fine display. (It became so brilliant that at Harvard's Oak Ridge station in Massachusetts celestial photography had to be stopped to avoid fogged plates.) As the amateurs dispersed, they expressed appreciation of the hospitality of the Springfield Telescope Makers and the hope for a repetition of the Stellafane convention next year.

Indexes and Bound Volumes

All volumes of Sky and Telescope are fully indexed, and the indexes are available at 35 cents each postpaid. Send 35 cents in stamps or coin or include with your renewal check or money order. Bound volumes, at $6.50 each postpaid, are also now ready for Volumes II, IV, V, and VI.

SKY PUBLISHING CORPORATION

Amateur Astronomers

MEETING OF THE AAVSO

The 37th annual fall meeting of the AAVSO will be held on October 15 and 16, 1948, at Harvard College Observatory, headquarters of the society. The first event will be a joint meeting on Friday evening, October 15th, with the Bond Astronomical Club and the Amateur Telescope Makers of Boston. Dr. Charles H. Smiley, director of Ladd Observatory, Brown University, will speak on "To Siam for an Annular Eclipse."

Saturday morning, at 10:00 a.m., the business session will be held, followed by papers of 10 minutes each. The afternoon session, at 2:00 p.m., will precede an observatory tea and the group photograph. The concluding event of the program is the annual dinner, at 7:30 p.m. Various astronomers will give short addresses on the August congress of the International Astronomical Union.

CLASSES FOR AMATEURS IN NEW YORK CITY

The Amateur Astronomers Association, New York, has announced its schedule of lectures and classes for the 1948-1949 season. Features of the new program are a home study course and observing sections for beginners and advanced students.

The beginners observing group meets every Friday for instruction and general celestial observing with telescopes, weather permitting. The advanced section is on the first and third Thursdays of each month for study and the observation of variable stars. The regular classes are in elementary astronomy (Fridays), intermediate astronomy (Mondays), and advanced astronomy (Tuesdays). Registration fee is two dollars per course.

Home study is conducted by Miss Aileen A. Pindar and Miss Hazel Boyd for members who are unable to attend the regular classes. A fee of five dollars covers registration, textbook, and a series of lessons and assignments.

The regular classes in telescope mirror making will be conducted by the AAA Optical Division in the workshop of the Hayden Planetarium. Twenty weekly sessions (Tuesdays or Wednesdays) include lectures and consultation on telescope design, with special consideration for each individual's requirements. The fee for course and materials is $35.00.

Information on all these courses and on membership in the AAA, which has over 650 members, may be obtained from the secretary, George V. Plachy, American Museum of Natural History, New York 24, N. Y. A foreign membership in the society has been established, at five dollars per year.

INDIANA OBSERVING

For the benefit of its members and any interested friends, the Indiana Astronomical Society has recently inaugurated a series of observation nights at the telescopes of members. The society **Bulletin** says, "Since these people will show the sky with their own telescopes, at their own homes, some one or more should be so located that every person interested in astronomy will be able to be there." Eight members in and around Indianapolis have already agreed to keep open one night each month for observation, and dates for each "at home" are to be announced every month.

THIS MONTH'S MEETINGS

Chicago: Dr. W. S. Krogdahl, of Dearborn Observatory, will speak to the Burnham Astronomical Society on Tuesday, October 12th, 8 o'clock in the Chicago Academy of Sciences auditorium. His topic is "Astronomy and Superstition."

Columbus: "Physical Methods in Astronomical Problems" will be the topic of Dr. C. E. Hesthal, of the department of physics, Ohio State University, before members of the Columbus Astronomical Society, on Tuesday, October 26th. The lecture will be accompanied by demonstrations and will start at 8:00 p.m., in the McMillin Observatory.

Geneva, Ill.: Members of the Fox Valley Astronomical Society will be guests of Director Wagner Schlesinger at the Adler Planetarium, Chicago, on Tuesday, October 5th, at 8 o'clock.

Indianapolis: The Indiana Astronomical Society will meet on October 3rd, 2:15 p.m., at Cropsey Hall, when Jack Forbes and Robert Mouser will speak on "What Star Names Mean."

Kalamazoo: At the October 9th meeting of the Kalamazoo Amateur Astronomical Association, to be held at 8:00 p.m. at the home of Mr. and Mrs. Max Kester, 2244 Brook Drive, "The Philosophy of Astronomy" will be discussed by H. V. Hilker.

New Haven: At Yale University Observatory on Saturday, October 23rd, New Haven Amateur Astronomical Society members will hear Dr. Rupert Wildt lecture on the "Constitution of the Planets."

New York: Dr. Harlan T. Stetson, Cosmic - Terrestrial Laboratory, Massachusetts Institute of Technology, will speak on "The Sun and Related Phenomena," at the meeting of the Amateur Astronomers Association on October 6th, Wednesday, at 8:00 p.m., in the American Museum of Natural History.

Stamford, Conn.: Friday evening, October 22nd, at the Stamford Museum, Courtland Park, S. I. Gale, of the Hayden Planetarium, will give an illustrated talk on "The Origin and Destiny of the Universe," at the meeting of the Stamford Amateur Astronomers.

Washington, D. C.: On Saturday evening, October 2nd, at 8:15 p.m., John A. O'Keefe, mathematician in the Army Map Service, will speak on "The National Geographic Society Eclipse Expedition to Rebun Jima, May 8-9, 1948," at the National Capital Astronomers meeting in the Commerce Department auditorium.

American Astronomers Report

Here are highlights of some papers presented at the 79th meeting of the American Astronomical Society at Pasadena, California, in June. Complete abstracts will appear in the Astronomical Journal.

Comets and Meteor Radiants

JUPITER's secular perturbations on certain comets cause a rotation of their lines of nodes in the plane of the ecliptic, as well as a periodic motion in their inclinations, while the aphelion and perihelion distances of the comets are very slightly affected. Therefore, it is possible for such comets occasionally to cross the ecliptic at the intersections with the earth's orbit and to give rise to showers of meteors, provided that the comets' perihelia lie inside the earth's orbit and their aphelia lie inside Jupiter's orbit.

An application of Brouwer's theory of secular perturbation of Jupiter on comets, which is valid for comets of inclination less than 36 degrees, has been made by Salah Hamid, of Harvard College Observatory. He has found that Encke's comet and Comet Grigg-Skjellerup are the only two periodic comets that satisfy the necessary criteria.

He finds that, as already shown by Dr. Fred L. Whipple, of Harvard, Encke's comet gives rise to night showers, the Taurids. But this same comet can also produce two daylight showers, one on June 12th, radiating from a point in right ascension 65°.7, declination +26°.1, and one on May 19th, at 43°.5, +13°.2. The first of these showers appears already to have been detected with radar by the English investigator A. C. B. Lovell.

Four showers are found possible from Comet Grigg-Skjellerup. Two occur at night, on January 21st at 107°, +9°, and on February 9th at 131°, +26°, both of which seemed to be observed visually by Opik and the American Meteor Society. Two daylight showers, both observed with radar by Clegg, Hughes, and Lovell, occur on June 21st, at 105°, +15°, and on May 31st, at 83°.5, +37°.

Band Spectra Data

ASTROPHYSICISTS seeking to identify the red and infrared emission and absorption features of stellar spectra have at their disposal laboratory data for the leading features of many atomic spectra. The situation for molecular spectra is not so favorable. Although the bands of molecules are absent or inconspicuous in the spectra of stars of the earlier classes, they assume increasing importance beginning at class *G* and become the outstanding features of the red stars of classes *M, R, N,* and *S*.

In particular, the heavy absorption in stars of class *M* is due to titanium oxide, whereas that in class *S* stars is due to zirconium oxide. Although work on bands of these compounds has been done as far out as 11,238 angstroms, the bands of longest wave length for both TiO and ZrO have not been classified in vibrational schemes.

Now Dr. C. C. Kiess, physicist at the National Bureau of Standards, reports that in response to several requests for infrared wave-length data on band spectra, Bureau of Standards' spectrograms of Ti and Zr have been re-examined. The wave lengths of outstanding band features are entered in tables prepared for astronomical use. With each tabulated wave length are given a numerical intensity estimate and letters describing its character.

Ursa Major Cluster Motions

STUDIES of moving star clusters are of great interest because they furnish reliable standards and controls for stellar luminosity and radial velocity investigations. The Ursa Major moving cluster is of special importance because its members are close to us and the kinematics of the cluster may be expected to furnish exceptionally reliable data.

Previous work on this cluster has revealed a serious discrepancy between the cluster motion values determined from cross motions (motions across the sky) and from radial velocities (motions in the line of sight determined by the Doppler shift of spectral lines). But the discrepancy had not heretofore been emphasized because of the difficult nature of the radial velocity determinations.

Now Dr. R. M. Petrie reports that at the Dominion Astrophysical Observatory new radial velocities have been determined with high dispersion and new wave lengths for 19 of the cluster stars. The velocities obtained are free of systematic error and are of satisfactory accuracy; they confirm the previously discovered discrepancy. Analysis shows that the radial motions of a compact group of 11 stars within some 20 light-years of the center of the cluster differ substantially from those of the more separated members.

This difference in velocities may be considered as indicating that the nucleus stars have a motion not the same as that of the larger, extended stream. In this case, the two groups of stars cannot remain long in apparent association, and the extent of the Ursa Major cluster as a whole appears no longer certain.

Abundance Abnormalities

CHARGE-TRANSFER is a process proposed by Dr. Jesse L. Greenstein, formerly of Yerkes and McDonald Observatories and now on the staff of California Institute of Technology, to explain the apparent abnormal distribution of the elements in the atmospheres of the metallic-line stars, such as Tau Ursae Majoris. Excessive ionization by radiation in the Lyman lines and continuum may provide an alternative but less probable explanation.

A detailed quantitative analysis of spectra procured with the large coude spectrograph of McDonald Observatory has shown one typical metallic-line star of spectral class *F* to have apparently only about 10 per cent as many atoms of calcium, scandium, zirconium, magnesium, titanium, and vanadium, as compared to the sun, while the other elements are present in normal amounts. In two other normal *F* stars studied all elements were present in normal amounts, but two supergiants, 1,000 times brighter than the dwarf *F* stars, showed a slight tendency to have too few atoms of the same elements as were lacking in the metallic-line star.

Spectroscopic observation, however, can inform us only how many atoms exist in the neutral state or in given stages of ionization: the spectra of the neutral and singly ionized metals are observable, but those of doubly ionized metals (each atom having lost two electrons) could not be detected in an *F* star. Thus, if an element appears to be missing in an *F* star, the cause may be a true abundance deficiency or excessive double ionization caused by some unusual physical condition in the star.

Such second ionization does occur in hot stars, but if high temperature were the cause, the neutral and singly ionized atoms of all elements with ionization potentials below a certain value would be unable to produce lines in the observable part of the spectrum. Instead, in metallic-line stars only those elements with second ionization potentials between 12 and 16 volts are affected. A *selective ionization process* is required, and this requires deviations in the star's thermodynamic equilibrium.

Perusal of Table XXXVIII in the appendix of Volume II of *Astronomy*, by Russell, Dugan, and Stewart (Ginn and Company, 1938), reveals some of the singly ionized atoms for which energy in the range 12 to 16 electronvolts is required to remove an additional electron. These, with their ionization potentials, are as follows: Mg+, 14.97;

$Ca+$, 11.82; $Sc+$, 12.80; and $Ti+$, 13.60. The first atom on the list is hydrogen, and Dr. Greenstein points out that its ionization potential is 13.54 — this is the energy required to remove the single ring electron from a hydrogen nucleus, and it is also the energy released when an ionized hydrogen nucleus captures an electron to become neutral once more.

It is this last change which is involved in the process known as *charge-transfer*. A quantum-mechanical resonance permits an electron to jump from an atom (say a singly ionized metal) to an ionized hydrogen atom, but only if the second ionization potential of the metal is nearly the same as the 13.54 ionization potential of hydrogen. The energy difference is balanced by changes in kinetic energy; thus, if a metal requires 14.5 volts to ionize it, there must be a loss of one volt in kinetic energy. Such small kinetic energies are common in an *F* star's atmosphere, while quanta of light energy, which might also produce the second ionization of the metals, are very rare. Dr. Greenstein finds that on the assumption of equal cross sections of the atoms for radiation and for collisions, there are about 10,000 times as many collisions possible with protons (hydrogen nuclei) as with light quanta.

At present, lack of laboratory data for collision probabilities between ionized and doubly ionized particles prevents accurate quantitative predictions, but it is expected that the collisional-ionization cross section decreases rapidly on either side of 13.5 volts. Thus, all elements with second (or first) ionization potentials near 13.54 volts should be excessively ionized. This exactly describes the observed apparent abundance deficiencies — involving elements with ionization potentials between 12 and 16 volts in both the metallic-line stars and the supergiants.

Dr. Greenstein pointed out that not far below the photosphere, even in the sun, a large region exists where the hydrogen and other gases are ionized and mechanically unstable. Clouds of slightly hotter than normal gases rise in turbulent motion, possibly producing such surface disturbances as the granulations, and even the prominences, chromosphere, and corona. In *F*-type stars, only the metallic-line stars give abnormal evidence of such instability, and in this they resemble the supergiants, which have such turbulence to a marked degree. Already the supergiants have been noted as having the same apparent abundance deficiencies, though on a reduced scale, as does a metallic-line star.

As hot masses of ionized hydrogen rise from the convective zone of a metallic-line star, the protons are greedy for electrons, to such an extent that they rob the nearest atoms of the elements which have just the right energy properties for such charge-transfers. The hydrogen then becomes neutral electrically, the robbed atom becomes doubly ionized and loses its ability to produce normally observable lines in the star's spectrum. In closing his paper Dr. Greenstein said: "If this theory proves correct, at least one striking case of apparent abundance differences among the stars can be removed from our list of stellar abnormalities."

A Cosmological Model

ACCEPTANCE of the expanding universe as a reality, at least as a basis for theories on the nature of the universe, was advocated by Dr. Guy C. Omer, Jr., research fellow in astrophysics at California Institute of Technology.

The chief departure of Dr. Omer's theory from earlier work on the structure, motion, and age of the universe is that he makes the assumption of a non-homogeneous distribution of matter. Previously theorists have tried to use homogeneous models, but it has been shown that these are unstable and will change over into non-homogeneous forms. "The number of ways in which the universe may be constructed is infinite," Dr. Omer said. "A homogeneous distribution of matter is only one out of an infinite selection of possibilities. Thus the odds are against it."

But he does assume a spherically symmetric distribution of matter, which he calls a logical first approximation to any non-homogeneous distribution of matter. He rules out the need for such things as Milne's two kinds of "time," Dirac's suggestion that physical constants vary with time, and Zwicky's concept of the "leaking quantum" or "tired light." He adopts the observed fact that the spectra of very distant galaxies are shifted strongly to the red, indicating that they are expanding away from us with velocities which increase in proportion to the distance — the expanding universe.

Following the work of Dr. E. P. Hubble, of Mount Wilson Observatory, Dr. Omer adopts tentatively an average density of matter in our galaxy's part of space of about 10^{-29} grams per cubic centimeter. Then he adjusts his constants to obtain an "age" or time-scale of the universe of about 3,640,000,000 years, in agreement with astronomical theories and the probable age of the earth. He then finds that the universe is very large, only a small fraction of it having been surveyed with the 100-inch telescope. His analysis gives results which fit in with observed counts of the galaxies at the limit of that instrument.

In emphasizing the tentative nature of this theory, Dr. Omer pointed out that the red shifts for the more distant galaxies have really been extrapolated, not measured, and that it remains for the 200-inch telescope to get more data on the magnitudes and Doppler shifts for the very distant galaxies.

Rapid Electronic Computer

EXTREMELY RAPID solution of some of the complex and laborious numerical problems of astronomy may soon be available by means of EDVAC, the Electronic Discrete VAriable Computer, which is being put through a long period of testing this summer and fall at the Moore School of Engineering, of the University of Pennsylvania. The expected performance of EDVAC on some astronomical problems was described by Dr. John B. Irwin, of the Flower Observatory, University of Pennsylvania.

The new calculator is comparatively small in size, some seven feet high and taking up 140 square feet of floor space. It uses 3,300 commercially available vacuum tubes, and 128 specially developed mercury tanks that form its acoustic-type memory and enable the machine to hold 1,024 13-digit numbers or orders. Multiplication and division of 13-digit numbers can be done in 2.9 milliseconds, that is, at the rate of 350 multiplications or divisions a second. Addition and subtraction are over three times as fast. (*Sky and Telescope,* VII, 149.)

EDVAC is an outgrowth of ENIAC, the first successful high-speed electronic computer, also built at the Moore School. EDVAC has a memory 50 times larger than ENIAC. The set-up for a problem in the new machine is done *off* the machine, while the machine is at work on some other problem. This is accomplished by putting the necessary orders and numbers on a magnetic wire recorder that can be plugged into the machine quickly. The answers to the problems, in turn, are recorded by EDVAC on another magnetic wire, and this output reel is then used to activate a page printer.

As his first example, Dr. Irwin gave one which he said was almost trivial from the machine's point of view. Most mathematicians, physicists, engineers, and astronomers are familiar with Peters' seven-place tables of sines and tangents, tabulated for every thousandth of a degree. Suppose one wanted to tabulate the sine of x for every *ten* thousandth of a degree, to *10* instead of seven decimal places. The results would constitute a volume some five times or more larger than Peters' tables and would contain 900,000 10-digit numbers. On EDVAC, about eight values of $\sin x$ could be computed in a second, and the whole table in a day and a half. But Dr. Irwin pointed out that the speed of printing the numbers, not the speed of EDVAC's "brain," would limit the operation.

Among astronomical problems to be solved by EDVAC, he mentioned specifically the solution of equations concerning eclipsing double stars; the calculation of the positions of stars and their

(Continued on page 310)

NEWS NOTES

By Dorrit Hoffleit

COMPLETION OF MISS CANNON'S WORK

During her 45 years of service to the Harvard College Observatory, Dr. Annie J. Cannon classified the spectra of nearly 400,000 stars. At the time of her death in April, 1941, nearly 90,000 were still unpublished. Her chief assistant, Mrs. Margaret Walton Mayall, undertook the completion of the unfinished portion of the work Miss Cannon had had in immediate progress.

Wartime activities prevented earlier publication of the now completed Volume 112 of the Harvard *Annals*. This second volume of the *Henry Draper Extension* contains charts of star fields on which the spectral classes of the stars are marked. Nearly all of the areas selected for inclusion in this volume are rich star fields in the Milky Way.

We note that Miss Cannon's last work was done in the Carina region in which she began her observations of stellar spectra on May 14, 1896.

ANNIVERSARIES AT WASHBURN OBSERVATORY

The Washburn Observatory of the University of Wisconsin and its retiring director, Dr. Joel Stebbins, celebrated their 70th birthdays simultaneously last spring at a joint meeting of the Midwest group of astronomers, the Madison Astronomical Society, and the staffs of Washburn, Dearborn, and Yerkes observatories. Dr. Jesse L. Greenstein, now of California Institute of Technology, has assembled in *Popular Astronomy* the papers presented. These give a good picture of the development of photoelectric photometry. In this comparatively new field Dr. Stebbins has been the outstanding pioneer and Washburn Observatory has the foremost reputation.

In 1908, young astronomer Stebbins presented a paper before the American Astronomical Society giving results of his early experiments in measuring with a galvanometer the decreased electrical resistance when starlight shone on crystalline selenium. With a 12-inch telescope, 1st- and 2nd-magnitude stars could then be measured with about the same accuracy as with visual methods. Within a year the sensitiveness was increased a hundredfold, and by 1910 Dr. Stebbins' measures of Algol revealed for the first time the existence of the secondary minimum of the light curve. The depth of this minimum, only 0.06 magnitude, was measured with a probable error for a single observation of two per cent.

In 1918, Stebbins and Kunz together observed a total solar eclipse with a Kunz photocell, work which "had profound effect upon precision photometry." Stebbins is quoted as saying then that to make a big telescope out of a little one all you had to do was to get a good Kunz cell. Ever since then the Wisconsin astronomer has been making telescopes grow. With the 200-inch instrument, it is now possible to reach stars of magnitudes 21-22 with an accuracy of 0.001 magnitude. The improvement in four decades is a factor of more than a million in brightness and 20 in accuracy.

Dr. Stebbins is "retiring" to Lick Observatory, of the University of California, where photoelectric photometry is already a major research. Meanwhile, Washburn Observatory promises well to live up to the precedents established by its recent director.

A RARE ASTRONOMICAL TREATISE

In 1848, Ormsby MacKnight Mitchel, founder of the Cincinnati Observatory (1843), wrote a book, *Exposition of the Discoveries and Theories of Modern Astronomy*. Several months ago, correspondence between the observatory and A. T. G. Brito, of Mt. Lavinia, Ceylon, revealed that the latter had acquired a copy of the volume while the observatory, where the treatise had been written, had none. Now, through Mr. Brito's generosity, 100 years old and from halfway around the world the rare book has "come home."

THE UNIVERSE AND THE ELEMENTS

Discussing the expanding universe in a recent issue of *Scientific American*, Dr. George Gamow, professor of physics at George Washington University, points out that the usual interpretation of the red shift as a Doppler effect would imply an age for the universe of less than a billion years, in comparison with estimates of the age of the earth as at least two billion. But the implicit assumption on which such an unreasonable youth of the universe depends is that the galaxies have kept a constant luminosity over such long periods of time. Galaxies, like everything else, are evolving. On the assumption that an average galaxy loses merely five per cent of its luminosity in 500 million years, the age of the universe is brought into agreement with other astronomical, geological, and physical evidence.

On the basis of the theory of the expanding universe Gamow, Alpher, and Bethe have attempted to reconstruct the process by which the various chemical elements may have been created during the early stages of the expansion. The temperature and pressure in the nucleus of the primordial matter must have been so great that it consisted entirely of free neutrons moving too fast to stick together to form stable nuclei. As expansion started, this gas began to cool and neutrons collected into unstable aggregates, emitting electrons until a state of electrical equilibrium was reached. The electrons fell into orbits about the nuclei, forming atoms. The results of the computations indicate that the formation of the elements must have started five minutes after the maximum compression of the universe and was fully accomplished about 10 minutes later. After that the density had become too low for further nuclear building processes and the relative abundances of the elements in the universe has remained essentially constant throughout the subsequent history of the universe (two or three billion years). The relative abundances of the elements computed on this theory are found to agree closely with the abundances observed in the stars.

And since this inspiring discussion was published Dr. Gamow has gone farther. In *Science News Letter* (July 31st) he figures that galaxies were formed when the universe was about 1/10 as old as it is now. Moreover, he has computed theoretically the size and mass of a galaxy and has obtained results which agree with astronomical findings for some of the observed galaxies.

MEDALS FOR MERIT

The Medal for Merit is one of the highest honors that can be bestowed upon civilians for assistance in the war effort. *Science* has recently reported on this award to 65 scientists and engineers of the wartime office of the Office of Scientific Research and Development, in recognition of outstanding services to the armed forces. Among these we recognize the names of astronomical workers — Dr. James G. Baker, then of Harvard Observatory, now research associate at Lick; Dr. Max Mason, California Institute of Technology; and Dr. Robert R. McMath, of the McMath-Hulbert Observatory, University of Michigan.

COSMIC RAY COMPASS

Navigation by cosmic rays and without a compass may seem a bit far fetched but it has been seriously proposed. It is one of the projects of an atomic research program at the University of Chicago. As noted in *Science Digest*, scientists for three months made regular B-29 flights between Labrador and Peru and observed variations with latitude in the direction and intensity of the cosmic rays. Their observations, made at 37,000 feet, may provide the basis for a navigation system in which cosmic rays would indicate the latitude.

On Wednesday, August 11th, at the west door of the Swiss Federal Institute of Technology, this official to

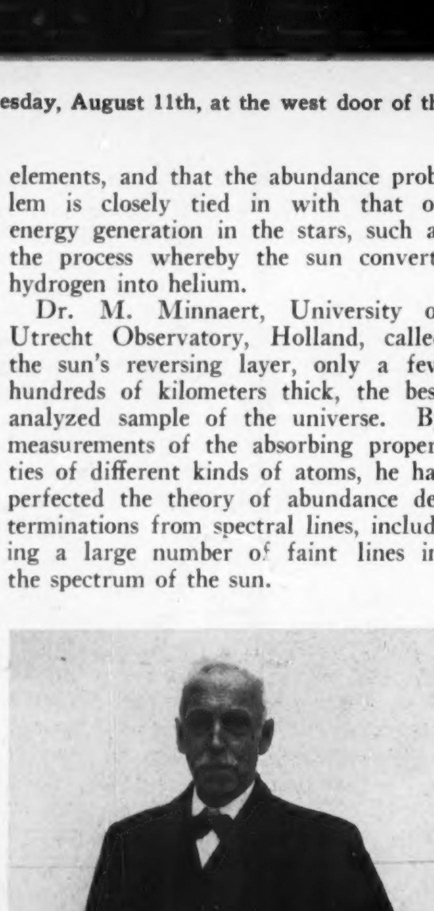
CONGRESS IN SWITZERLAND

(Continued from page 292)

accurately maintained at a point near 42°.5 centigrade. At Zurich for the first time, also, were shown new McMath-Hulbert Observatory motion pictures of the entire surface of the sun, also in hydrogen light. The pictures, presented by Dr. Orren C. Mohler, compress into 12 minutes the events of 180 hours of observing of 1½ solar rotations during April and May of this year. They show 45 solar flares, an average of one flare every four hours. Flares commonly occur in sunspot regions, and are seen as a sudden brightening of the light emitted by several of the solar elements, such as hydrogen and calcium, occasionally helium. Flares are not seen, however, in direct observations of the sun. Although in these new pictures the entire solar disk is observed at the sacrifice of image scale, the advantages of patrolling the whole sun at one time are obvious.

Eight astronomers took part in the symposium on the abundances of the elements, which was held Tuesday afternoon, August 17th, the last scientific gathering before the sessions of the general assembly the following day. Dr. Otto Struve, of Yerkes and McDonald Observatories, head of the American delegation to the IAU, was chairman of the symposium. He described the problem of the relative distribution of the elements in the sun, the earth, and the stars. He pointed out that some stars show an apparent deficiency in certain elements, and that the abundance problem is closely tied in with that of energy generation in the stars, such as the process whereby the sun converts hydrogen into helium.

Dr. M. Minnaert, University of Utrecht Observatory, Holland, called the sun's reversing layer, only a few hundreds of kilometers thick, the best analyzed sample of the universe. By measurements of the absorbing properties of different kinds of atoms, he has perfected the theory of abundance determinations from spectral lines, including a large number of faint lines in the spectrum of the sun.



Dr. Ejnar Hertzsprung, of Denmark, photographed informally while on a boat excursion on Lake Zurich.

Dr. J. Hunaerts, of the Royal Observatory at Uccle, Belgium, presented a list of 18 elements for which the number of molecules in a unit cross section of the sun's atmosphere have been determined. While these figures may err by a factor of 2, they show, for elements heavier than neon, a remarkable similarity to the chemical composition of the earth's crust and of meteorites. But the sun must be taken as more representative of the universe than the earth or meteorites, as the latter may have lost their shares of the lighter elements, such as hydrogen, helium, and oxygen, during their younger days.

The following are the logarithms of relative abundances of elements in the sun, as determined by Dr. Hunaerts: hydrogen, 10.0; heavy hydrogen, less than 5.0; helium, 9.30 (?); carbon, 6.89; nitrogen, 7.08; oxygen, 7.18; sodium, 4.28; magnesium, 5.51; aluminum, 4.33; silicon, 5.29; sulphur, 4.92; potassium, 3.20; calcium, 4.23; scandium, 1.33; titanium, 2.96; vanadium, 2.06; chromium, 3.58; iron, 4.99.

Continuing the discussion of astrochemistry, as he called it, Dr. A. Unsöld, University of Kiel, Germany, said that in the stars he could see no possibility of elements heavier than oxygen taking part in energy generation. Among stars of the main sequence, the abundances closely resemble those in the sun: for every atom of *any* metal there are about six atoms of carbon, nitrogen, and oxygen; 500 atoms of helium; and 5,000 atoms of hydrogen. Although we cannot be sure of the internal constitution

official photograph was taken of persons at that time attending the congress of the International Astronomical Union.

of these stars, it appears evident that they have converted very little of their hydrogen into helium.

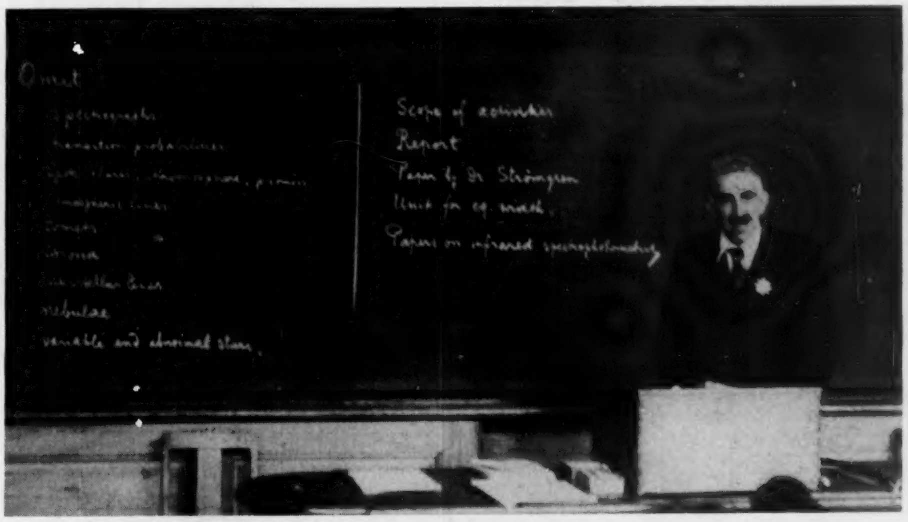
It is with this problem that Dr. F. Hoyle, University of Cambridge, England, has been concerned. He has theoretically determined the mass-luminosity relation for hypothetical stars with varying hydrogen-helium abundances. Comparison with the masses and brightnesses of most real stars indicates that hydrogen is still their main constituent. Dr. Hoyle believes that violent convective currents within the stars keep them well mixed, so that the outer layers may be taken as having the same composition as the interiors, where the nuclear energy processes occur.

A hypothetical star with a mass at least 40 times that of the sun, and a three-mile core at its center with a density 10^{14} times that of water, was proposed by Professor O. Klein, of the Technological Institute, Stockholm, Sweden, as a possible manufacturer of the heavy chemical elements. The central temperature in this core would be 10 billion degrees, which would allow conversion of neutrons and other atomic particles into heavy chemical elements. But as no stars are known with the properties such a core would require, it may well be that only in the early history of the universe were there suitable states of high pressure and density — since then the abundances of heavy elements may not have changed appreciably. But Professor Klein's theory makes it feasible to account for the transmutation of the lighter elements under conditions in the stars today.

Planetary nebulae and interstellar matter pose observational difficulties in the abundance problem, but Dr. Donald H. Menzel, Harvard College Observatory, and Dr. Bengt Stroemgren, University of Copenhagen Observatory, currently conclude that the relative abundances of the elements are, respectively, the same in planetary nebulae and in interstellar matter as in the stars. Dr. Menzel now believes many planetary nebulae to be filamentary in their structure. In one case the filaments are about 17 times as dense as had heretofore been assumed for a planetary nebula as a whole.

As for the apparently abnormal stars, Dr. Struve stated that such anomalies as the metallic-line stars may now be explained by special processes or situations (see page 299). In some cases, however, age differences among stars may produce apparent deficiencies in hydrogen, especially where hot stars, which expend their energy and their hydrogen at a rapid rate, are concerned.

(To be continued)



Dr. M. Minnaert, Utrecht Observatory, Holland, proposes streamlining the work of Commission 36, spectrophotometry, by omitting discussion of those subjects listed on the blackboard on the left in the picture. Photographs in this article, except the group picture above and that of the Institute of Technology on page 292, are by the editor.

The STARS ARE YOURS

By James Sayre Pickering

Yes, the stars are yours—without a telescope, for emphasis here is on celestial objects which can be seen unaided. This vivid book discusses our solar system, its sun, moons, planets and asteroids, visiting meteors and comets, our galaxy—and many fascinating phenomena. Charts and photographs are most helpful. $3.95

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BOOKS AND THE SKY

FUNDAMENTALS OF PHOTOGRAPHIC THEORY

T. H. James and **George C. Higgins.** John Wiley and Sons, Inc., New York, 1948. 286 pages. $3.50.

THIS BOOK will be of interest to astronomers concerned with photographic photometry, as well as to anyone, professional or amateur, who wants to know why photographic materials behave as they do, and what they can or cannot be made to do. It is not intended to be a handbook or formulary, but is a presentation of the chemical and physical theory of the photographic process.

In its 286 pages, the book covers the preparation of photographic emulsions; the formation of latent images; various exposure effects such as reciprocity law failure and the intermittency effect; the mechanism and kinetics of development, and the composition and chemical reactions of the developing agent and the developing solution; theoretical considerations in fixing and washing; sensitometry; the theory of tone reproduction; the structure of the completed image (including graininess, turbidity, and the Eberhard and related effects); and finally the processes of sensitizing emulsions to different wave-length regions.

While the approach is largely theoretical, the authors constantly keep in mind the actual conditions of practice, so that it would be difficult to read this book without deriving a number of practical suggestions. In the three chapters on sensitometry, the practical problems of obtaining data useful for photographic theory are discussed, and many of the considerations of these chapters are also of importance to astronomical photography. The material on the theory of tone reproduction is of great importance to anyone making pictures for scientific records, as well as for beauty, though the purely astronomical applications of this subject are limited.

Even though the first chapter defines all the terms used in photography and outlines the whole process of making a picture, I would not consider this book the best as a first introduction to the subject for a person who previously knew nothing of darkroom routine. But as a reference work for one who uses photography, or is interested in photography for its own sake, it should prove very valuable. The publishers state that the book can be understood by anyone who has a basic knowledge of physics and physical chemistry. This is quite true, since almost every new term, even if of general chemical or physical meaning, is explained briefly. Each chapter is concluded with general references as well as specific references to recent literature, and there is good cross reference within the book; these features enhance its usefulness.

No specific discussion of the mechanism of hypersensitization of the finished plates before exposure, as by baking or bathing in ammonia or water, is given. This would have been of interest to astronomers.

The volume is well illustrated with graphs, line drawings, and photographs. Photomicrographs and electron micrographs of individual grains and cross sections of the emulsion before and after development are especially to be mentioned.

ROBERT FLEISCHER
Rensselaer Polytechnic Institute

NEW BOOKS RECEIVED

READINGS IN THE PHYSICAL SCIENCES, *Shapley, Wright,* and *Rapport,* 1948, *Appleton-Century-Crofts.* 501 pages. $3.00.

Emphasis here is on contemporary work in English in fields of physical science grouped as astronomy, geology, mathematics, physics, and chemistry. The first group of readings is on science and scientific method.

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TERMINOLOGY TALKS -- J. Hugh Pruett

Umbra, Penumbra

In discussions of lunar eclipses our almanacs are often puzzling in their free use of the terms *umbra* and *penumbra*. Some persons even doubt the accuracy of the advance data for they observe nothing exceptional when the moon is scheduled to "enter penumbra." Umbra means shadow; penumbra, almost shadow.

In explanation, let us consider a relatively small area near the visible edge of the moon. As the earth gradually comes between the sun and moon, only part of the sun's light is at first blocked off from this area. It is positively not in a shadow, but only in diminished sunlight. Continuously more of the sun's face is hidden by the earth and the illumination of the area becomes less. This is the penumbral stage, which requires expert observation to detect. Finally, when the earth blocks all direct sunlight from this point, the actual shadow, the dark umbra, settles on it. Observed on the moon as a whole, the intensity of the penumbra is greatest next to the umbra and gradually shades out — becomes brighter — from there.

Appulse

Some lunar eclipses never get to the umbral stage, but content themselves with the penumbral alone since the earth's umbra misses the moon by a slight amount. Such phenomena, never mentioned in most almanacs, are called penumbral eclipses, or *appulses*. Astronomical magazines sometimes carry their prediction.

The writer on one occasion experimented on methods of naked-eye observation of the penumbra when it alone was on the moon. Steady gazing at our lunar neighbor failed to show the phenomenon. But when the eyes were closed for a short time, then suddenly turned on the moon, it was easily noted that one side of the lunar disk had a decidedly dirty appearance. However, in a few seconds, as the pupils of the eyes began to contract due to the bright light, the effect disappeared. It is hoped sometime to experiment with filters of various densities.

In total lunar eclipses the moon usually remains dimly visible as a ghostly, dark-red sphere due to the bending of some sunlight into this region by the earth's atmosphere. Many believe that the Biblical statement that "the sun shall turn into darkness and the moon into blood" was a reference to the little-understood phenomena of eclipses.

Orbit

An orbit is a track, or path. The orbits of the planets and comets which belong to our solar system are continuous, generally considered closed paths relative to the sun. The orbits of the principal planets are so nearly circular — although never exactly so — that diagrams of these drawn to a small scale usually require measurements to show that they are slightly wider in one direction than at right angles to it.

The elongation, or ellipticity, of planetary orbits is most noticeable for Mercury and Pluto, the planets nearest to and farthest from the sun. The orbits of the asteroids, or minor planets, those hundreds of little bodies which circulate mostly between the tracks of Mars and Jupiter, are in most cases easily seen to be elongated. The ellipses which represent cometary orbits are generally even more elongated, that is, of greater eccentricity. A typical comet is thus at times relatively near the sun, much nearer in many cases than is the earth, then later at a great solar distance, when the comet wanders in the dim spaces usually thought to be the rightful realm of the most distant planets.

Perihelion, Aphelion

The Greek word for sun is *helios*. Combining this with *peri* (around, or about) and *apo* (from, or away from) we have the two words perihelion and aphelion ("ph" here is sounded as "f"). Literally these words mean "around the sun" and "from the sun." In astronomical usage they indicate the points of a body's nearest approach to and most distant recession from the sun.

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GLEANINGS FOR A. T. M.s

THE COMPOUND REFLECTING TELESCOPE — VI

By Allyn J. Thompson

If the primary mirror is perforated, this should be done prior to figuring to avoid possible later surface disfigurement due to the release of strains in the glass.* (Similarly, with a perforated optical flat, the hole should be cut before attempting to figure.) For making the perforation, copper, brass, or aluminum tubing (in order of preference) should be used. A 3" or 4" length of the tubing is mounted as shown in Fig. 20. The teeth in the cutting edge can be made with a file. The metal core on which the tube is fitted is turned concentric in a lathe so that when mounted in the drill press it will run true. As a guide to starting the perforation exactly concentric in the mirror, a wooden disk, **a**, is turned up and recessed to fit neatly over the mirror's edge, and at the same time a central hole of a size that will just admit the tubing is bored in it. Perforation is done with the mirror face up, using No. 150 carbo and water. There is no danger of scratching if reasonable care is exercised, and a cleaner cut is had by starting at the front surface. There will be minor chipping at the back surface upon breaking through; this can be minimized by backing up the mirror blank with a plaster-of-Paris disk which has first been cast on that surface. In the course of perforation, the tubing should not be continuously engaged, but alternately raised and lowered, thus allowing the abrasive grains to drop into the slot to be put to work.

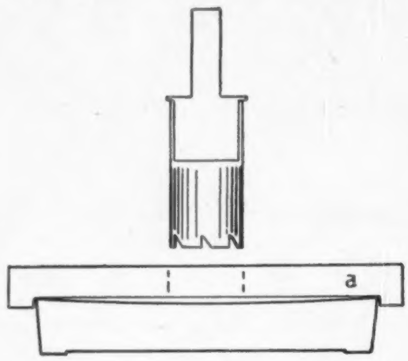

Fig. 20. Perforating the mirror.

Using 1½" outside diameter aluminum tubing with a 1/32" wall, and a drill-press speed of about 200 r.p.m., about 1½ hours were required to cut completely through a 6-inch pyrex mirror. In the process 7/32" of the tube's length was worn away. The diameter of the hole in the mirror tapered from 1.290" at the front surface to 1.260" at the back. The diameter of the core tapered from 1.175" to 1.150".

To clean the sludge from the mirror, immerse it in a basin of hot soapy water and lightly slosh its surface with a bit of saturated absorbent cotton. The sharp edge of the hole should be chamfered with No. 400 or No. 600 carbo. To do this, turn a 45° taper onto a short length of solid metal stock or thick-walled tubing of suitable diameter, and, while it is still in the lathe, paint the tapered surface with carbo and water. Gripping the mirror securely, bring the edge of the central hole against the rotating abrasive-coated surface.

Before the start of figuring, the center of the polishing lap will have to be cut away. It may be preferred by some to do the perforating upon completion of grinding, but there is no reason why the mirror should not first be completely polished.† The hole is no handicap to

*ED. NOTE: Some telescope makers will not agree with the author's methods of figuring a perforated mirror, expecting them to bring about turned-down edge and figuring difficulties. After some 12 years of talking with all kinds of mirror makers, this editor has found that what one ATM swears by may be anathema to another. Mirror figuring is like salad making — each newcomer must work out his own technique.

†ED. NOTE: It would be advisable in every case such as this, when the perforation is to be made, to test the mirror by transmitted light, using a polaroid filter. This should determine if any strains in the glass exist, to be released by the perforation. Many mirror makers feel that by perforating the mirror at an early stage (grinding) and replacing the plug with paraffin any strains which might be released can be **ground** out, avoiding the possibility that they might be too pronounced to be removed by polishing and figuring techniques.

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lap-making, however, and for the molded lap the procedure is just as though the mirror's surface were intact. For the channeled lap, a paraffin-paper ring the size of the hole should be centered on the tool and held there while the pitch is poured around it. Accidents can always happen, and if something occurs that necessitates a return to grinding, the tool will then have to be perforated.

For these deep mirrors, the pitch lap should be of mild temper if the figure is to be finished spherical, and on the soft side if correction is to be made. Rapid stroking may have to be resorted to in order to reach full correction. On large and deep mirrors, a greater measure of success in figuring may be had with subdiameter laps, used with the mirror facing upward. Obstinate zones and other local defects are more effectually treated by such laps, in fact, the entire polishing operation can be accomplished in this way.

Except when intended for purely localized correction, the subdiameter lap is generally half the mirror's diameter and made star-shaped, as at **a**, or **b**, Fig. 21. In the case of a perforated mirror, the lap is equal to the semidiameter of the mirror minus the semidiameter of the hole. The lap at **b**, if made about two-thirds diameter, is useful in parabolizing, and for cleaning up zonal irregularities left by a

A 10-inch Cassegrainian mirror being finished with a subdiameter tool. In this case, the perforation plug was cemented in place. Photo by R. E. Cox.

smaller polisher. Care should be used in the distribution of the work with these subdiameter tools to avoid introducing astigmatism. The rose-petal lap at **c**, made full diameter, is excellent for reducing overcorrection, or for taking down any high zone. In shaping this lap, the petals are given the greatest width in the radius of the zone to be reduced. To avoid turned-down edge in all of this on-top polishing, not more than 1/6 of the tool's diameter should overhang the mirror at the termination of the stroke. If it is impossible to avoid turned-down edge surrounding the perforation, the inner zones of the primary will be stopped off by the secondary obstruction, for axial image points at any rate. Contact is equally as important with small laps as with large, and cold-pressing may not

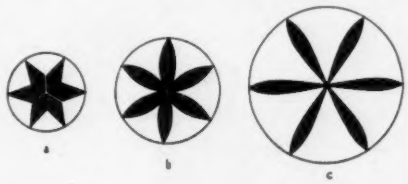

Fig. 21. Laps for correcting the primary mirror.

be neglected. The tools on which these laps are formed need not be convexed to fit the curve of the mirror, but may be flat, of glass, metal, hardwood, or plaster of Paris.

The Secondary Mirror. Unless quite a large telescope is being made, the secondary will be too small to be worked entirely by hand. But by grinding and polishing a large glass disk to the required radius, the secondary can be cut from it. That, in substance, is the method of manufacture, but surface disfigurement will inevitably follow cutting, and this must be provided for. The procedure about to be described worked satisfactorily for the writer.

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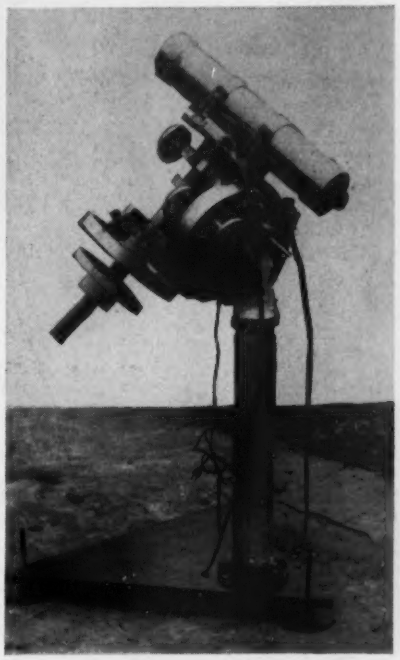

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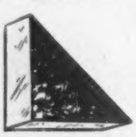

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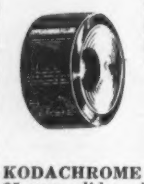

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as tools, should be ⅝" to ¾" in thickness. The third disk, from which the secondary will be cut, should be about ½" thick. (For large telescopes, where the secondary's diameter will be in the neighborhood of 3" or more, pyrex should be used.) The thin disk is to be cemented to one of the thicker tools with paraffin, but first their surfaces are brought to a perfect fit by being mutually ground together with several charges of No. 400 carbo, the final charge being worked down quite fine and with lessening pressure. The disks are then placed on a board and thoroughly warmed in an oven. When sufficiently heated a stick of paraffin is drawn across the surface of the thicker disk until a thin film of molten wax covers its surface, care being taken to exclude dust particles. The secondary blank is then pressed forcibly on top of it, squeezing out all surplus paraffin, and held there under pressure until the disks have cooled.

The third disk is used as a tool to grind the curve onto the secondary blank. After finishing with No. 120 carbo, with the exact radius of curvature attained, the secondary is cut out in the manner described for perforating the mirror. As for the choice of tube size for cutting the secondary from the larger blank, it has been found that the cut-out secondary will be about 0.02" less in diameter than the internal diameter of the tube, employing No. 220 carbo.

Both parts of the blank are now removed from the supporting tool, as the cemented joints are under strain due to tension releases in the substance of the glass. The paraffin is cleaned off, and the core and the outer ring are again ground, separately this time, and each in its approximate position, with short strokes against the surface of the supporting tool. Two or three charges of No. 400 carbo, used with light pressure, will suffice for this second "mating" of the surfaces.

The next concern is to guard against future scratches by chamfering the edges of both the secondary blank and the outer ring. The method described for similarly treating the hole in the mirror can be used on the ring, and the bevel on the tube used for this purpose may then be reversed for chamfering the secondary. To be effective, the chamfer should be about 1/16" wide; thus part of it should still remain when fine grinding is completed.

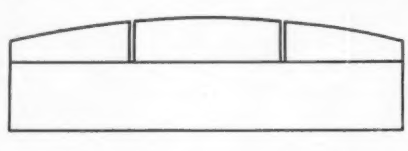
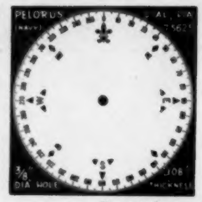


Fig. 22. Secondary and supporting ring assembled for polishing.

Both pieces of glass are now recemented to the supporting disk (Fig. 22). During the perforating process, if the tube is allowed to penetrate a few thousandths of an inch into the lower disk, the resultant grooved ring will serve as a guide to centering the pieces. One or two pounds of pressure, evenly distributed, should be maintained while the glass is cooling.

It is unlikely, however, that the secondary and surrounding ring will be per-



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fectly concentric, and a little work in truing up the overall surface and restoring the continuity of the curve will be necessary. This should be done with No. 120 carbo. When the change to successively finer grades is made, if a few abrasive grains remain lodged in the crevice, and cannot be flushed out, they can be sealed in permanently by flowing in a few drops of shellac from the tip of a small brush.

Making the Lap. As no heat may be permitted to penetrate the paraffin-cemented secondary combination, heat cannot be used in lap-making. Instead, a plaster-of-Paris replica is cast on the concave glass tool, and is used to impress the curve on the lap. To make the plaster disk, wrap a paraffin-paper collar around the tool and pour into it a stiff mix of plaster and water, to a depth of at least ¾". When the plaster has set, remove the collar to facilitate drying, and when the casting has hardened slide it off the tool. While preparing for lap-making, warm the plaster cast in an oven, and prior to pressing it down onto the molten pitch (which has already been poured onto the warmed concave tool), thoroughly paint its convex surface and sides with a creamy mixture of water and rouge. This will prevent the pitch from sticking to the plaster. When the pitch is fairly cool, the plaster cast can be lifted off. If a perforated rubber mat was used in making the lap for the mirror, it can be used here too. For a channeled lap, several narrow strips of cardboard or other pliant material, four or five inches in length, and up to ⅛" square in section, should first been dipped in melted paraffin. These strips can then be spread on the poured pitch, parallel to each other and equally spaced; thus rows of channels will be formed at the same time that the lap is shaped by the plaster disk. Squares are then easily made with a sharp knife by cutting grooves at right angles to the channels.

After coating the lap with beeswax, soften it slightly by immersing it for some minutes in hot water, and then press it into shape with the secondary combination. A slightly raised ring marking the circular perforation will be formed on the lap in this process, as well as during subsequent cold-pressings, but it will quickly flatten out once polishing gets under way, without doing any harm.*

Due to the steepness of the curve it will be found more expedient to do most of the polishing with the lap on top, although this method is wasteful of the polishing compound. It is advisable to perform the final polishing in this reversed position. Maintain contact through frequent cold-pressing, and vary the stroke to blend in any chance zones. As a result of these precautions, and because of the relatively great thickness of the secondary and the steepness of its curve, the emergent figure

*ED. NOTE: If some workers find that this raised ring invariably causes a turned-down edge, a circular channel may be cut in the lap in this region, but others may aver that such a concentric channel would cause figuring difficulties. When a block of small flats, fastened to a tool with plaster of Paris, is pressed, similar raised zones are formed, but these usually cause no trouble.

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STAFF: *Director*, Wagner Schlesinger. *Other lecturers:* Harry S. Everett, Albert B. Shatzel.

BUHL PLANETARIUM

**Federal and West Ohio Sts., Pittsburgh 12, Pa.
Fairfax 4300**

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director*, Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

October: COLUMBUS AND THE STARS. The story of the first great voyage of Columbus and how he navigated by the stars in his discovery of a new world.

November: STARS OVER PITTSBURGH and POETRY IN THE STARS.

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SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director*, Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

October: MOON LORE. The wet moon, dry moon, harvest moon, hunter's moon, blue moon, and many other moons that have been named in the past will be discussed and demonstrated.

November: TO THE ENDS OF THE UNIVERSE.

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STAFF: *Director*, Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

October: OUR STAR, THE SUN. Similarities and contrast between the sun and various other stars which will be pointed out in the sky are considered.

November: COMETS AND METEORS.

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STAFF: *Honorary Curator*, Clyde Fisher. *Chairman and Curator*, Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale.

October: AUTUMN SKIES. With the lengthening of nights the stars attract increasing attention. The many wonders of the autumn constellations will be in our October sky drama.

November: A FLIGHT TO THE ANTARCTIC.

will in all probability be within 1/8 of a wave length of a sphere.

The polished secondary is now ready to be edged to its correct diameter in the lathe. A device to be used for this purpose is shown in Fig. 23. A brass plate is fastened to the inclined edge of a board so mounted that the whole thing can be wedged or clamped in the toolpost holder of the compound rest. A short length of tubing, not less than 1/16" in wall thickness, and of smaller diameter than that of the finished secondary, is faced off square

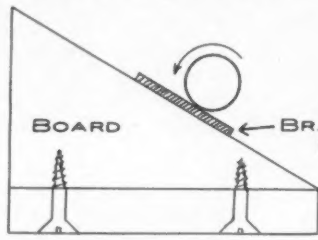

Fig. 23. Arrangement for reducing the secondary diameter.

in the lathe. It is then heated, and the faced end dipped in molten pitch. The secondary, which has meanwhile been heated, is then stuck to the tube (by its back surface), and while this is revolving in the lathe, with the pitch still soft, the secondary is centered by bearing against its spinning edge with a pencil or hardwood stick. When running true, cold water is wrung over the pitch joint from a saturated sponge or cloth, thus hardening the pitch binder. The wet sponge or cloth is then held against the tube until all heat has left it, when edging can begin. Feed a little No. 220 or 400 carbo and water onto the brass plate and bring it against the edge of the secondary, with the spindle turning at high speed. It takes but a couple of minutes to reduce the diameter by about 1/20", so proceed with caution.

To remove the secondary, rest it and the tube on a wooden bench, place the edge of a sharp knife or razor blade over the pitch joint, and strike it a sharp blow. After cleaning up, the secondary is ready for use in the Dall-Kirkham telescope, or for further correction for the Cassegrainian.

(To be continued)

OPTICAL SOCIETY

The Optical Society of America will hold its 33rd annual meeting at the Hotel Fort Shelby in Detroit, Mich., from October 21st to 23rd. All interested persons are invited to attend, and non-members of the society may secure copies of the program from the secretary, Dr. Arthur C. Hardy, Massachusetts Institute of Technology, Cambridge 39, Mass.

An exhibit of optical instruments and equipment by 10 companies will be open during the meeting. A new feature of the schedule is the plant visit program on October 20th. Twenty-two firms, schools, hospitals, and research organizations in the Detroit area have invited members of the OSA to visit their institutions.

AMERICAN ASTRONOMERS REPORT

(Continued from page 300)

motions from catalogue-type photographs such as those taken at Yale University Observatory; the study of stellar statistics and motions; solutions of a special case of the problem of three bodies; and reduction of data from the measurement of stellar motions by their spectra. As for the preliminary computation of the orbit of an asteroid or a newly discovered comet, the time to get the preliminary orbital elements, to make a complete least-squares correction, and to run out a short list of predicted future positions would be only about 75 seconds!

Thus, the new machine is so fast that its ultimate efficiency will probably depend on the proper programming of jobs for it to do, and on the assigning to it of problems too difficult or laborious even to attempt at present. New calculating methods may involve more calculations to save programming time. Needed, too, are faster specialized measuring machines for such observational material as coude spectrograms and Schmidt camera plates. The Institute of Numerical Analysis at the University of California at Los Angeles plans to install an improved EDVAC.

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City	*Organization*	*Date*	*P.M.*	*Season*	*Meeting Place*	*Communicate with*
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ATLANTA	Atlanta Ast'mers	3rd Fri.	7:30	Sept.-June	Agnes Scott College	W. A. Calder, Agnes Scott College
BATTLE CREEK	†B. C. A. A. Club	2nd Fri.	8:00	Oct.-June	Kingman Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
BEAVER, PA.	†*Beaver Co. A.A.A.	4th Tue.	8:00	Sept.-June	Com'y Bldg. Tamaqui	Mrs. R. T. LuCaric, Box 463, Baden
BROOKLYN, N. Y.	Astr. Dept.	3rd Thu.	8:15	Oct.-April	Brooklyn Inst.	Brooklyn Institute
BUFFALO	†*A.T.M.s & Observers	1st, 3rd Wed.	7:30	Oct.-June	Mus. of Science	R. Missert, 29 Crosby Ave., Kenmore
CAMBRIDGE	†*Bond Ast. Club	1st Thu.	8:15	Oct.-June	Harvard Obs.	Miriam Dickey, Harvard Observatory
"	†*A.T.M.s of Boston	2nd Thu.	8:00	Sept.-June	Harvard Obs.	Frank M. Roe, 35 Pemberton St. (40)
CHATTANOOGA	Barnard A. S.	2nd Fri.	8:00	Oct.-May	Jones Observatory	C. T. Jones, 302 James Bldg., *CHat.* 7-1936
CHICAGO	†*Burnham A. S.	2nd Tue.	8:00	Sept.-June	Chi. Acad. of Sciences	J. M. Showalter, 6200 Kenmore Ave.
"	Chicago A. S.	Monthly	8:00	....	Adler Planetarium	Adler Plan., *Wabash* 1428
CINCINNATI	*Cin. A. A.	2nd Fri.	8:00	Sept.-June	Cincinnati Obs.	T. R. Stoner, RR 8, Cin. 30, *BE* 7937-R
"	*Cin. A. S.	3rd Wed.	8:00	Sept.-June	5556 Raceview Ave.	A. C. Moore, 5548 Raceview Ave. (11)
CLEVELAND	Cleveland A. S.	Fri.	8:00	Sept.-June	Warner & Swasey Obs.	Virginia Burger, Warner & Swasey Obs.
COLUMBIA, S. C.	North'n Cross A.S.	Every Mon.	8:15	All year	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
COLUMBUS, OHIO	*Columbus A. S.	Last Tue.	8:00	All year	McMillin Obs.	J. A. Hynek, Ohio State Univ.
DAYTON	A.T.M.s of Dayton	3rd Sat.	Eve.	....	Private homes	W. C. Braun, New Lebanon
DAYTONA BEACH	D. B. Stargazers	Alt. Mon.	8:00	Nov.-June	500 S. Ridgewood Ave.	Rolland E. Stevens, 500 S. Ridgewood
DETROIT	†*Detroit A. S.	2nd Sun.	3:00	Sept.-June	Wayne U., Rm. 187	E. R. Phelps, Wayne University
"	†*N. W. Detroit A.S.	1st Tue.	8:00	Sept.-June	Redford High Sch.	John W. Broxholm, 21412 Pickford
DULUTH, MINN.	†*Darling Ast. Club	1st, 3rd Fri.	8:00	All year	Darling Observatory	Mrs. Rachel Bulkley, 1317 N. 5 St., Superior, Wis., 4507
GADSDEN, ALA.	Ala. A. A.	1st Thu.	7:30	All year	Ala. Power Audit.	Brent L. Harrell, 1176 *W* or 55
GENEVA, ILL.	*Fox Valley A. S.	1st Tue.	8:00	....	Geneva City Hall	Joseph Zoda, 501 S. 6th, St. Charles
HOUSTON	*Houston A. S.	Last Fri.	7:30	All year	Mus. Nat. Hist. Annex	Mrs. Johnnye Murray, 1007 W. Gray (6)
INDIANAPOLIS	†Indiana A. S.	1st Sun.	2:15	All year	Riley Library	E. W. Johnson, 808 Peoples Bank Bldg.
JACKSONVILLE	*J. A. A. C.	1st, 3rd. Mon.	8:00	All year	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
JERSEY CITY, N. J.	†Revere Boys Club	Mon., Tue.	7:15	All year	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
JOLIET, ILL.	†Joliet A. S.	3rd Mon.	8:00	Oct.-May	Jol. Township H. S.	Mrs. Robert L. Price, 403 Second Ave.
KALAMAZOO	†Kalamazoo A.A.A.	Sat.	8:00	Mar.-Dec.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
KANSAS CITY	*A. A. & T. M.s	4th Sat.	8:00	All year	Private homes	Reginald Miller, Merriam, Kans.
KEY WEST, FLA.	†Key West Ast. Club	1st Wed.	8:00	All year	Private homes	W. M. Whitley, 1307 Div. St., 724-R
LOS ANGELES	L.A.A.S.	2nd Tue.	7:45	....	Griffith Obs.	H. L. Freeman, 853½ W. 57 St.
LOUISVILLE, KY.	†L'ville A. S.	1st Tue.	8:00	Sept.-May[1]	Univ. of Louisville	B. F. Kubaugh, 621 34th St.
MADISON, WIS.	†Madison A. S.	2nd Wed.	8:00	All year	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
MIAMI, FLA.	South'n Cross A.S.	Every Fri.	7:30	All year	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26th Road
MILWAUKEE	†*Milw. A. S.	1st Thu.	6:15	Oct.-May[2]	City Club	E. A. Halbach, 2971 S. 52 St., W. Allis
MINNEAPOLIS	M'polis A. C.	1st, 3rd Wed.	7:30	....	Public Library	Mrs. M. S. Skahen, 500 Ridgew'd Ave. (4)
MOLINE, ILL.	†*Pop. Ast. Club	Wed.[3]	7:30	Feb.-Nov.	Sky Ridge Obs.	Carl H. Gamble, Route 1
NASHVILLE	*Barnard A. S.	2nd Thu.	7:30	All year	Vanderbilt Univ.	E. Keller, 2716 Hartford Dr. (11), 5-0766
NEW HAVEN	†New Haven A.A.S.	4th Sat.	8:00	Sept.-June	Yale Obs.	Mrs. Eda Becroft, Box 28, Yalesville
NEW ORLEANS	A.S. of N. Orleans	Last Wed.	8:00	Sept.-May	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
NEW YORK	*A.A.A.	1st Wed.	8:00	Oct.-May	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., *EN.* 2-8500
"	†Junior Ast. Club	3rd Sat.	Aft.	Oct.-May	Amer. Mus. Nat. Hist.	J. B. Rothschild, Hayden Plan., *EN.* 2-8500
NORFOLK, VA.	†*A.A.S. of Norfolk	2nd, 4th Mon.	8:00	All year	Commonwealth Apts.	P. N. Anderson, 2320 Ballentine Blvd. (2)
NORWALK, CAL.	Excelsior Tel. Club	Thu.	7:00	All year	Excelsior Union H. S.	Geo. F. Joyner, 410 Sproul St.
NORWALK, CONN.	Norwalk Ast. Soc.	Last Fri.	8:00	Sept.-June	Private houses	Mrs. A. Hamilton, 4 Union Pk., 6-5947
OAKLAND, CAL.	*Eastbay A. A.	1st Sat.	8:00	Sept.-June	Chabot Obs.	Miss H. E. Neall, 1626 Chestnut, B'keley
OWENSBORO, KY.	†*Owensboro A. C.	3rd Sat.	8:00	All year	Public Library	Herman Batt, 1507 Hathaway St.
PALO ALTO, CAL.	†*Ast. & Tel. Club	1st Fri.	7:30	All year	Community Center	Miss D. Rossiter, 922 Roble Ave., Menlo Pk.
PHILADELPHIA	†A. A. of F. I.	3rd Fri.	8:00	All year	The Franklin Inst.	Edwin F. Bailey, *Rit.* 3050
"	*Rittenhouse A. S.	2nd Fri.	8:00	Oct.-May	Morgan Physics, U. Pa.	Sarah Lippincott, Sproul Obs., Swarthmore
PITTSBURGH	†*A.A.A. of P'burgh	2nd Fri.	8:00	Sept.-June	Buhl Planetarium	Charles H. LeRoy, R. D. 2 (15)
PONTIAC, MICH.	*Pontiac A.A.A.	2nd Thu.	8:00	All year	Private homes	Mrs. M. Chircop, 147 Prospect St., 21455
PORTLAND, ME.	†A. S. of Maine	2nd Fri.	8:00	All year	Private homes	H. M. Harris, 27 Victory Ave., S. Portland
PORTLAND, ORE.	†*Portland A. S.	1st Wed.	7:00	All year	Central Pub. Lib.	H. J. Carruthers, 427 S. E. 61 Ave.
"	†A. T. M. & O.'s	2nd Tue.	8:00	All year	Private homes	N. C. Smale, 831 N. Watts St.
PROVIDENCE, R. I.	Skyscrapers, Inc.	Mon. or Wed.	8:00	All year	Ladd Observatory	Ladd Obs., Brown U., *GA.* 1633
RENO, NEV.	A. S. of Nev.	4th Wed.	8:00	All year	Univ. of Nevada	G. B. Blair, University of Nevada
ROCHESTER, N. Y.	Roch. Ast. Club	Alt. Fri.	8:00	Oct.-May	Univ. of Rochester	Edwin M. Root, 110 Hamilton St.
ROCKY MOUNT, N.C.	Hi-Y A. C.	Tue.	8:00	....	YMCA	J. A. Harper, YMCA
RUTHERFORD, N. J.	Rutherford A. S.	1st Thu.	....	....	Private homes	W. C. Fillebrown, 273 Lawton Ave.
SACRAMENTO	*Sac. Val. A. S.	....	8:00	All year	Sacramento College	Mrs. Helen Schopke, 3111—12 Ave. (17)
SAN DIEGO, CAL.	Ast. Soc. of S. D.	1st Fri.	7:30	Oct.-June	504 Elec. Bldg.	W. T. Skilling, 3140 Sixth Ave.
"	†A.T.M. Ast. Club	2nd, 4th Mon.	7:30	All year	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, *Bayview* 3757
SCHENECTADY	†S'tady Ast. Club	3rd Mon.	8:00	All year	Schenectady Museum	G. Staffa, 32 Front St.
SOUTH BEND, IND.	St. Jos'ph Val. Ast.	Last Tue.	8:00	All year	928 Oak Street	F. K. Czyzewski, South Bend Tribune
SPRINGFIELD, VT.	†Springfield T. M.'s	1st Sat.	6:00	All year	Stellafane	John W. Lovely, 27 Pearl St., 535-W
ST. LOUIS	St. Louis A. A. S.	1st Sat.	....	All year	Private homes	A. M. Obrecht, 2913 Park Ave.
STAMFORD, CONN.	*Stamford A. A.	4th Fri.	8:00	All year	Stamford Museum	Wm. L. Dutton, Box 331, Noroton
TACOMA, WASH.	Tacoma A. A.	1st Mon.	8:00	All year	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 No. Union Ave.
TEANECK, N. J.	†Bergen Co. A. S.	2nd Wed.	8:30	All year	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
TULSA, OKLA.	†Tulsa A. S.	Occasional meetings				V. L. Jones, 4-8462
WANTAGH, N. Y.	Long Island A. S.	Sat.	8:00	All year	Private homes	A. R. Luechinger, Seaford Ave., 1571
WARREN, OHIO	†Mahoning Val. A.S.	Thu.[4]	8:00	All year	Private homes	S. A. Hoynos, 1574 Sheridan, N.E., 25034
WASHINGTON, D.C.	†Nat'l Cap. Ast'mers	1st Sat.	8:00	Sept.-June	U.S. Nat'l. Museum	Jewell Boling, 1717 P St. N.W., *Du.* 2969
WICHITA, KANS.	†*Wichita A. S.	1st Wed.	8:00	All year	To be announced	Dollie Ratcliff, 801 Maple, 2-1822
WINSTON-SALEM	†*Forsyth A. S.	Last Fri.	7:30	All year	Private homes	Kenneth Shepherd, 703 W. E. Blvd.
WORCESTER, MASS.	†*Aldrich Ast. Club	1st, 3rd Tue.	7:30	All year	Mus. Natural History	Ralph A. Wright, 4 Mason St.
YAKIMA, WASH.	†Yak. Am. Ast'mers	2nd Mon.	8:00	All year	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.
YOUNGSTOWN	Y'town A. C.	1st Fri.	7:30	All year	Homestead Pk. Pav'n.	F. W. Hartenstein, 905 Brentwood

[1]June, Jul., Aug., informal meetings. [2]Dinner meeting. [3]Nearest 1st-quarter moon. [4]1st or 2nd Sun., June-Sept.

OBSERVER'S PAGE

Universal time is used unless otherwise noted.

New Comets and an Unusual Asteroid

C. A. WIRTANEN, who operates the 20-inch astrographic camera of Lick Observatory on a regular survey of galaxies, has incidentally discovered many faint members of the solar system. On July 15th, a 15th-magnitude comet was found, one which will not reach perihelion until April 30, 1949. Even then it will be 244 million miles from the sun, so that at no time is this comet expected to become bright. Comet 1948h has proven a very worthwhile object, however, for it led directly to the discovery of an unusual asteroid.

Harvard Announcement Card 918, issued on July 26th, reported the discovery of a rapidly moving object on a plate made July 17th by Mr. Wirtanen to obtain a position for Comet 1948h. In right ascension the new object was then only 1.7 minutes west of the comet, and in declination only 49′.6 south — a rather unusual coincidence. Very shortly thereafter Dr. L. E. Cunningham, of the Students Observatory, Berkeley, reported to Harvard:

"The present approach of this asteroid to the earth (0.125 astronomical unit) is essentially the closest one possible at the ascending node, but a closer one (0.07 a. u.) is possible at the descending node. A very much closer approach to Mars (0.01 a. u.) is possible at the ascending node."

The inclination of the orbit of the new asteroid is 9½°, but its perihelion distance (to be reached about October 7th) will be only about 72 million miles. Thus it becomes the fifth asteroid known to pass nearer the sun than does the earth. At the time of its discovery it was about 1.2 astronomical units from the sun, but during August it moved inward, crossing **above** (north of) the earth on the 15th of that month. A few days earlier, our planet and this tiny object were separated by about 11,650,000 miles, and the asteroid had a very rapid apparent motion across the sky. Plot the following positions on a star chart to verify this. The date in August is given first, followed by right ascension and declination:

August 1, $20^h\ 57^m.2$, +35° 25′; 5, $20^h\ 47^m.8$, +47° 34′; 9, $20^h\ 29^m.8$, +61° 01′; 13, $19^h\ 44^m.2$, +74° 15′; 15, $18^h\ 43^m$, +79° 58′; 17, $16^h\ 16^m$, +83° 34′; 19, $13^h\ 02^m$, +82° 35′; 21, $11^h\ 28^m$, +78° 47′. Note the close approach to the north celestial pole, a rather unusual part of the sky in which to observe an asteroid. During its conjunction with the sun, late in August, the asteroid was circumpolar and observable each night, of the 14th magnitude.

Another comet was found on August 26th, by Dr. Joseph Ashbrook at Lowell Observatory, of the 12th magnitude, in the constellation Aquarius. Comet Ashbrook will not increase much in brightness, for its nearest approach to the sun, late in April, 1949, is about 218 million miles. Its predicted positions, computed by Dr. A. D. Maxwell, Howard University, were: September 22, $22^h\ 48^m.8$, −13° 39′; September 30, $22^h\ 42^m.2$, −13° 04′.

Early in September a cablegram from international information headquarters at Copenhagen University Observatory announced the discovery of another comet, the 10th reported this year. It was found by Johnson, Union Observatory, Johannesburg, South Africa. The discovery magnitude was given as 13, and the comet's position was in Sculptor, not very distant on the sky from Comet Ashbrook.

Harvard Announcement Card 935, issued September 13th, gives parabolic elements for Comet Ashbrook computed by Dr. J. Bobone, Cordoba Observatory, substantially in agreement with Dr. Maxwell's figures. Also, observed positions for Comet Johnson by H. L. Giclas, Lowell Observatory, show that object to be moving westward and southward. It is of the 15th magnitude.

MINIMA OF ALGOL

(Universal time)

October 2, 22:19; 5, 19:07; 8, 15:56; 11, 12:45; 14, 9:33; 17, 6:22; 20, 3:11; 22, 24:00; 25, 20:48; 28, 17:37; 31, 14:26. November 3, 11:15; 6, 8:04.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See Sky and Telescope, Vol. VII, page 260, August, 1948, for further explanation.

METEORS IN OCTOBER

Observations this year of the Orionid meteor shower will be hampered by a morning gibbous moon. Maximum rates come about October 20th to 22nd, the meteors radiating from a point in northern Orion. However, as the shower has a duration of nearly two weeks, observations from October 15th through the 25th are advisable. At maximum, from 10 to 20 meteors per hour may be counted after midnight. E. O.

VARIABLE STAR MAXIMA

October 9, T Ursae Majoris, 7.9, 123160; 9, V Cassiopeiae, 7.9, 230759; 12, RT Hydrae, 7.6, 0824**05**; 17, RV Sagittarii, 7.8, 1821**33**; 19, R Leo Minoris, 7.2, 093934; 20, RS Scorpii, 6.8, 1648**44**; 21, T Aquarii, 7.9, 2044**05**; 22, S Carinae, 5.7, 1006**61**; 22, T Centauri, 6.1, 1336**33**; 27, RR Scorpii, 6.0, 1650**30**a; 29, X Centauri, 7.8, 1144**41**; 30, R Virginis, 6.9, 123307.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

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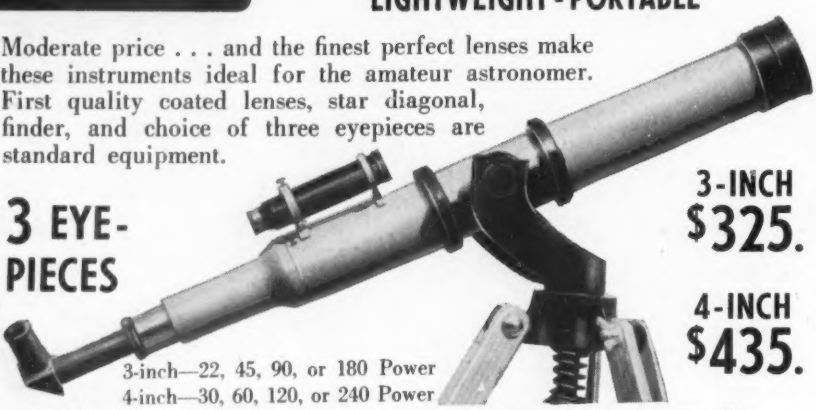

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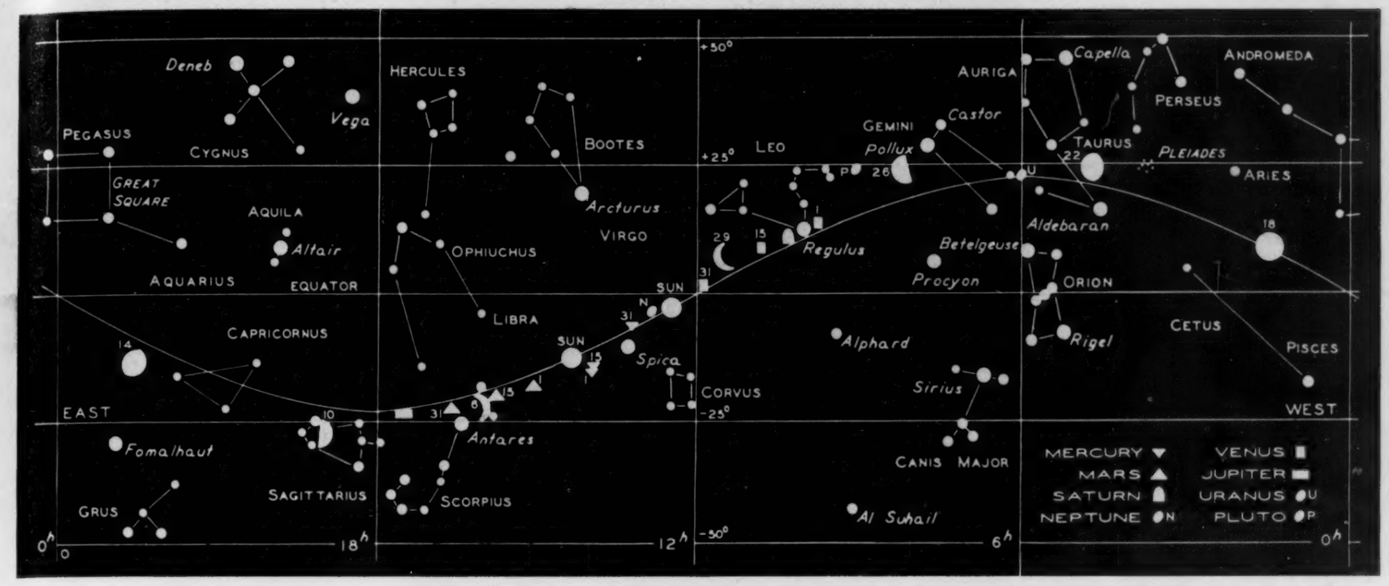


THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury opens the month as an evening star, but it is poorly placed for observation. Inferior conjunction with the sun occurs on the 20th, and the elusive planet rapidly assumes a favorable position for viewing in the morning sky. The last few days of October find Mercury rising 1½ hours before sunrise.

Venus continues as the brilliant apparition in the morning sky, rising about 3½ hours before the sun. Its stellar magnitude has decreased to —3.6, and with telescopic aid it appears in a gibbous phase. On October 6th, Venus passes ½° south of Regulus.

Mars will be a difficult object to view, as its setting time is 1½ hours after the sun and it is of 2nd magnitude. However, the three-day crescent moon may aid in locating Mars, for the planet will be 1° north, geocentrically, on October 5th.

Jupiter follows the sun, setting about three hours later; magnitude —1.6.

Saturn, located several degrees east of Regulus, in Leo, rises nearly four hours before the sun. The ringed planet is slightly brighter than the star, but both are greatly outshone by Venus, which passes 1° south of Saturn on the 8th.

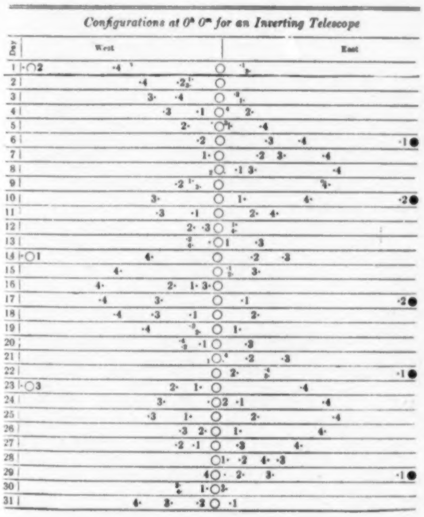
Uranus rises about three hours after sunset, located 22′ north of the star 1 Geminorum. Opera glasses are sufficient to view this distant planet.

Neptune passes conjunction with the sun on October 6th, hence is unobservable.

E. O.

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the UT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the American Ephemeris and Nautical Almanac.



OCCULTATION PREDICTIONS

October 9-10 **234 B Sagittarii** 5.9, 19:21.3 —27-58.1, 7, Im: **C** 1:28.1 —1.7 —0.9 86; **D** 1:20.9 —1.5 —0.6 75; **E** 1:02.2 —1.9 0.0 68; **F** 0:44.2 —2.7 +0.3 80; **H** 23:55.4 —2.1 +1.4 71.

12-13 **161 B Capricorni** 6.4, 21:59.3 —18-09.2, 10, Im: **A** 5:24.8 —1.4 —2.7 110; **C** 5:27.5 —2.2 —3.5 118; **D** 5:13.1 —1.3 —1.6 92; **E** 5:00.3 —1.7 —0.8 82; **F** 4:53.7 —2.9 —1.1 95; **G** 4:35.4 —0.7 +1.0 22; **H** 4:09.9 —1.6 +1.6 37; **I** 4:28.0 —0.5 +1.6 10.

23-24 **47 Geminorum** 5.6, 7:08.2 +26-56.6, 21, Em: **G** 7:41.9 —0.3 +1.6 263; **H** 7:15.3 +0.4 +2.0 232; **I** 7:37.7 —0.1 +1.4 271.

23-24 **BD +27° 1337m** 6.4, 7:09.6 +27-18.9, 21, Em: **A** 9:00.6 —1.9 —0.4 287; **B** 8:57.1 —1.8 —0.8 298; **C** 8:52.1 —2.0 +0.3 275; **D** 8:47.5 —1.8 —0.3 292; **E** 8:26.9 —1.6 +0.3 287; **F** 8:08.5 —1.2 +1.2 261; **H** 7:48.4 —1.1 —0.4 315.

25-26 **90 H¹ Cancri** 6.1, 9:10.6 +21-29.9, 24, Em: **A** 8:58.2 —1.4 +0.3 290; **B** 8:57.2 —1.3 0.0 300; **C** 8:49.8 —1.3 +0.8 277; **D** 8:49.9 —1.2 +0.3 294; **E** 8:36.3 —0.8 +0.7 287; **F** 8:21.5 —0.3 +1.4 257.

26-27 **Eta Leonis** 3.6, 10:04.5 +17-01.0, 24, Im: **C** 6:25.4 +0.7 +3.2 48. Em: **C** 6:54.0 —0.8 —1.9 346.

CORRECTION: Dr. Alice Farnsworth, Mt. Holyoke College, points out that on page 262, August issue, occultation predictions for the star **Psi² Aquarii** are correct for stations **C, E, F,** and **H,** but that the predictions given for stations **G** and **I** actually apply to the star **Psi³ Aquarii,** of magnitude 5.2.

For selected occultations visible at standard stations in the United States and Canada under fairly favorable conditions, these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, a and b quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	**E** +91°.0, +40°.0
B +73°.6, +45°.6	**F** +98°.0, +30°.0
C +77°.1, +38°.9	**G** +114°.0, +50°.9
D +79°.4, +43°.7	**H** +120°.0, +36°.0
I +123°.1, +49°.5	

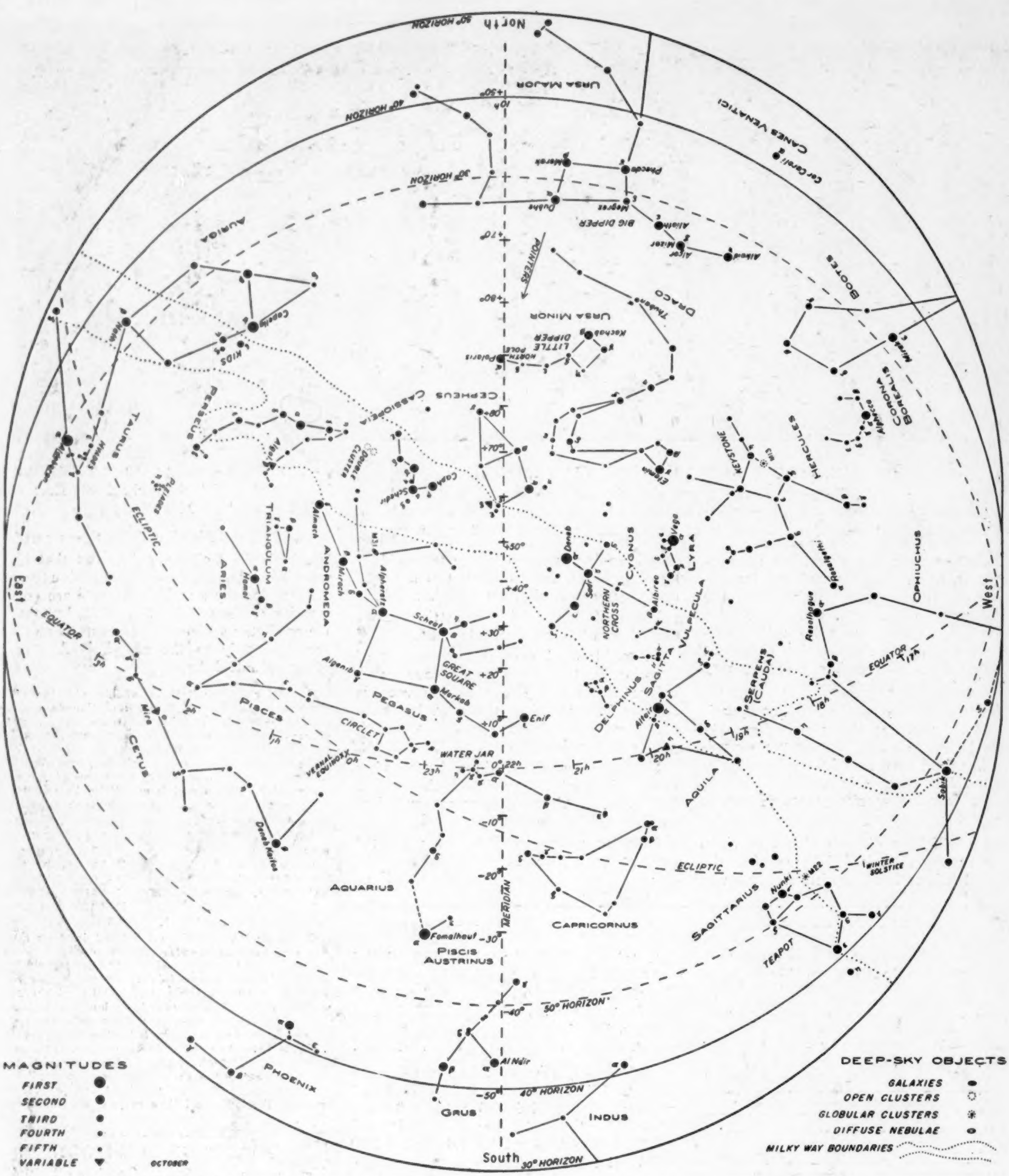
The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your own standard time.

PHASES OF THE MOON

New moon	October 2,	19:42
First quarter	October 9,	22:10
Full moon	October 18,	2:23
Last quarter	October 25,	13:41
New moon	November 1,	6:02

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.



DEEP-SKY WONDERS

As THE MERIDIAN moves away from the Milky Way and the constellations become actually arrangements of distinct stars instead of confused multitudes, clusters become rare and the external galaxies once more appear. But it must be remembered that atmospheric conditions play a great part and that a spiral clearly evident on one night will be beyond reach of the same instrument on another evening. In general the best seeing seems to come immediately after the passage of a cold front — within the next six hours.

NGC 7041, 21^h 13^m, $-48°$ $35'$, magnitude 12.2, angular size, 0.8 by 0.4 minutes of arc.

NGC 7049, 21^h $15^m.6$, $-48°$ $47'$, 11.8, 0.8 x 0.5.

NGC 7217, 22^h $5^m.6$, $+31°$ $7'$, 11.6, 3 x 2.5.

NGC 7314, 22^h 33^m, $-26°$ $18'$, 11.9, 3 x 1.3.

NGC 7331, 22^h $34^m.8$, $+34°$ $10'$, 11.2, 9 x 2; barred spiral.

NGC 7410, 22^h $52^m.1$, $-39°$ $56'$, 11.8, 4 x 1.

NGC 7479, 23^h $2^m.4$, $+12°$ $3'$, 11.9, 3 x 2.5.

WALTER SCOTT HOUSTON

STARS FOR OCTOBER

from latitudes 30° to 50° north, at 9 p.m. and 8 p.m. local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. For the year 1948, these simplified charts replace our usual white-on-black maps, which may be consulted in issues of prior years when information on deep-sky wonders and less conspicuous constellations is desired. Our regular charts for observers in the Southern Hemisphere appear in alternate issues.

EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Dec. 7th at 11 p.m., Dec. 23rd at 10 p.m., Jan. 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see alternate issues, December, 1946, to August, 1947; and November, 1947, to September, 1948.